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NATURAL SOURCES OF ENERGY.

AT the present time, everyone's attention has been very forcibly drawn to the question of the conservation of our national supply of coal, and to the desirability of supplementing this source of energy by others, even if only for reasons concerned with the labour problem.

This, then, is a very opportune moment for the British Science Guild to issue a preliminary Report of the Committee appointed by the Guild to consider the subject of our Natural Sources of Energy.

Sir William Ramsay is the chairman of the Committee, and the present publication contains the following reports from various members:—

Sources of Energy depending on Atomic Transformation, by Sir William Ramsay, K.C.B., F.R.S.;

The Internal Heat of the Earth as a possible Source of Energy, by Prof. the Hon. R. J. Strutt, F.R.S.;

Present and Prospective Supplies of Petroleum and Shale Oil available for use as a Source of Power, by Sir Boverton Redwood, Bart.;

The Coal Resources of Great Britain, by Dr. G. T. Beilby, F.R.S.;

The Effect of Temperature in the Carbonisation of Coal, and its bearing upon the Conservation of our Coal Supplies, by Prof. Vivian B. Lewes;

The Thermal Efficiency of Internal Combustion Engines, by Mr. Dugald Clerk, F.R.S.;

Efficiency in Steam Engines, by the Hon. Sir Charles A. Parsons, K.C.B., F.R.S.;

The Conservation of Water Power, by Mr. Walter F. Reid;

and there is a concluding note by the chairman.

Sir William Ramsay in his own Report, which is concerned with atomic transformation, repeats the statement which he made in his Presidential Address to the British Association, which address we considered at some length in our issue of September 1st, 1911.*

Nowadays, he says, the question is not—Can it be done? but, Will it pay to do it? And, so far as the production of energy from radium or any similar substance is concerned, the answer is emphatically in the negative. Perhaps radium will now take its true place as a natural marvel of problematical value. It has been represented up to now as a combination of the elixir of life, the philosopher's stone, and the source of all power, including the internal heat of the earth.

Prof. R. J. Strutt considers the possibility of pumping cold water into the hot interior of the earth, at places where this hot interior is accessible, and pumping it out again at a temperature suitable for use as a driving agency. This would involve the installation of iron pipes in molten rock, and Prof. Strutt ingenuously remarks that the engineering difficulties would be very great; with which opinion we think our readers will find themselves in agreement.

The question of the supply of petroleum, and of the distillation of petroliferous shale, is of more serious importance. Sir Boverton Redwood deals with this matter, and goes into

*ELECTRICAL REVIEW, Vol. 69, pp. 328, 329.

considerable detail, showing the output of crude petroleum from the various sources, and the possibilities of increased supplies. It is satisfactory to note that some considerable increase in the amount of petroleum produced within the limits of the British Empire may be looked for. In this connection Mr. W. H. Booth's article on page 527 of our issue of last week, in which he states that he has actually determined the presence of oil-bearing strata in England itself, is of special interest.

The sections contributed by Dr. Beilby, Prof. Lewes, Mr. Clerk, Sir Charles Parsons and Mr. Reid, remind us of two Presidential Addresses to the Institution of Electrical Engineers. Mr. James Swinburne, in 1902, considered the limits bearing upon various electrical engineering problems, amongst which were the tides—a report on wave power is to be expected from the British Science Guild later on—water-power, the steam engine, and the gas engine. Concerning this last, he noted that there was at that time considerable prejudice against the Diesel engine, because it was novel, and, from the condemnation it was receiving, he concluded that it was very good, which prophecy is now being proved correct. In 1910 our present President, Mr. Ferranti (who is also a member of this Committee), spoke upon the question of coal conservation, and made his famous "all-electric" proposition.

Briefly, the contributions concerned with coal, by Dr. Beilby and Prof. Lewes, tell us that we should extract the gas from coal, and use it for generating electricity, which could be cheaply transmitted from the pit mouth to the place where it was to be used. Prof. Lewes makes a great point of the advisability of using low temperatures in the coke ovens. The gas is richer, and could be diluted with water gas, which is much cheaper than coal gas. The coke left behind is better for burning, and there is more tar. Both writers insist strongly on the necessity for using recovery ovens, and doing away with those of the beehive type.

Mr. Dugald Clerk prophesied nearly 30 years ago that the internal combustion engine was coming, and he reminds us of this prediction in his Report. The Diesel engine is certainly coming very much to the front, together with other prime-movers consuming oil, and there seems very little doubt that when this kind of engine has been rendered more perfect, it will be largely used for the driving of electrical machinery. Mr. Clerk touches on the question of enforcing by law the use of gas power, but he thinks that even apart from vested interests, such action would be of doubtful benefit.

Sir Charles Parsons writes on the subject of large turbines and their efficiencies, pointing out that in such machines it is possible to convert 70 per cent. of the steam energy—not the heat energy—into work, while in small reciprocating units this efficiency may be halved.

Mr. Walter Reid writes an interesting note on water power, dealing also to some extent with afforestation.

The project lately put forward by Sir William Ramsay, of burning the coal at the pit bottom instead of at the top, opens up vast possibilities. We shall, however, postpone comment on this subject for the moment. We understand that experiments in this direction are to be undertaken.

The trend of thought among scientists of all professions is: (1) Burn your fuel economically; (2) Burn it centrally; and (3) Transmit by electricity. Thus we see that the prolongation of the industrial life of this country rests largely with electrical engineers, and we have no doubt that they will prove equal to the occasion.

The German Electrical Industry in 1911.

The situation of the electrical industry in Germany in 1911, exclusive of the business transacted by the four large firms, is discussed in the report issued by the Association of Electrotechnical Special Works, which is claimed to represent several hundreds of the smaller establishments. In general the year is characterised as having been favourable, as the special works succeeded in obtaining an increased turnover both at home and abroad, although the export trade advanced to a somewhat less extent than in 1910. It is now more difficult for the works to retain the foreign markets, as electrical manufacturers in other countries are becoming stronger under the protection of high import duties, and the circumstance that the exports of electrical products, which were formerly very considerable, will largely decline in the future—as, for instance, to Sweden—will have to be reckoned with. Notwithstanding the better condition of trade, prices further receded, although it was to some extent possible to equalise the decrease by improved manufacturing methods and the increased turnover. On the question of labour, the report remarks that the conditions were considerably more unfavourable than in 1910, since a large number of establishments were disturbed through partial strikes and through the lock-out of metal workers, especially in Berlin and Saxony, whilst at the same time a scarcity of skilled workers generally, was manifested.

The makers of electrical machinery, the report proceeds to state, were very well employed in general, although underselling by the large firms in the open market was specially perceptible. In the case of electric cables and insulated wires the works were also well occupied, but over-production still prevailed in the manufacture of lead cables, and this was also very largely the case in other countries. Although a syndicate for cables exists in the home market, all attempts hitherto made to establish a similar combination for insulated wires have failed. The branches concerned with the production of apparatus for heavy currents and of installation materials were likewise well employed, and in these cases also the larger volume of business and more rational methods of manufacturing, enabled the works to partly recoup themselves for the further fall in sale prices. On the other hand, the glow-lamp department was unsatisfactory, and the fresh reduction in the prices of metal-filament lamps last October scarcely permitted of the realisation of any profits. The arc lamp branch suffered from the tax imposed on lighting apparatus, and a similar observation also applies to the carbon department. Measuring instruments and meters afforded good employment, although prices became still more unfavourable. The makers of artificial insulating materials were well occupied, but the advent of fresh competition caused prices to be depressed. Business in insulating tubes in particular was brisk, although makers suffered from the establishment of new competitive works abroad.

The report, in conclusion, refers to the efforts made by the Governments of various of the Federal States to prevent the further creation of monopolies in installation work and materials. It is, however, considered that these endeavours can only be regarded as small remedies and as fragmentary work, seeing that the majority of the State and communal authorities, who have to place orders for plant and works to an increasing extent, entrust the contracts as a whole to the large firms without any division, and thereby exclude free competition in the trade.

Copper.

The upward tendency of copper prices, at the same time as tin is rising, is remarked upon by a writer in the *Financier* of March 25th. As he points out, the price has continued to rise in face of the labour deadlock. This is attributed to a degree of co-operation and regulation of output in advance of former conditions, as well as to shrinking stocks, and the existence of a bear account. The steady increase in the world's consumption is noted; it has risen from 720,000 tons in 1907 to 851,000 tons in 1910, and is estimated at 875,000 tons for last year. A factor in this is the large increase in consumption in Germany and France; for while in 1910 the German consumption was 117,169 tons, last year it rose to 135,487 tons, and that of France rose from a normal value

of 65,486 tons to 80,837 tons. In America the demand fell off by 13,891 tons, and in England it was stationary, though at a high figure, namely, 97,192 tons. The leading copper shares have, as is natural, participated in the rise, but not to the extent which would be expected. The American mines appear to be firmest in this respect.

Messrs. Merton's statistical circular, giving the whole production for last year, contains interesting statistics bearing upon the above. From these we find that Africa and Argentina show a good increase on last year, and Australia an appreciable production of 41,840 tons (nearly equalled, however, in 1907); Bolivia, Canada and Chile show a distinct falling-off in production. Cuba appears to be coming on, now showing 44,550 tons, whereas five years ago she did not figure in the statistics. Germany's output at 22,010 tons is good (for Europe), though only one-fifth of her consumption. Japan shows especially strong with 55,000 tons, an increase of 6,000 tons on her previous record (1907). Mexico, like so many of the countries of that hemisphere, shows smaller production, while Norway seems to have, for the present, reached the limit of her output at 9,400 tons. Peru and Russia have both increased, and show up well on past figures. Spain and Portugal show a small increase for Rio Tinto, whose production, however, is still 1,000 tons below the best, and a satisfactory return for the whole country of 52,045 tons. The United States shows an increase of 7,715 tons on 1910, and still maintains an increase, though the leading producing States have all fallen off except Arizona.

A note in the *Financial News*, quoting from the annual report of Messrs. A. Hirsch & Son, gives the German production of copper for last year (1911) at 37,500 tons, a quantity considerably higher than given in previous reports. The home consumption amounted to 238,745 tons, against 212,268 tons in 1910, the increase being due mainly to the growing development of the electrical industry, which absorbed 110,000 tons in 1911. Germany at 208,826 tons (consumption minus production) with England (159,736 tons) and France (106,408 tons) together consumed 501,129 tons, a quantity considerably in excess of the United States' 316,791 tons.

The continued rise in price is commented upon in the *Times* with reference to the possibilities of increased output with the newer producers. In this respect Australia shows an excellent record, putting out only 6,500 tons 20 years ago, and 42,000 tons last year. Japan, at 55,000 tons, was considerably in advance of Australia in 1892, then producing 18,000. Peru has risen from 7,580 tons in 1902 to 25,445 in 1911.

The Patents Report, 1911.

The twenty-ninth annual report of the Comptroller-General of Patents, Designs and Trade Marks shows a decrease of 4·2 per cent. (from 39,873 to 38,186), in the total number of specifications received during 1911, as compared with 1910. The number of applications accompanied by provisional specifications decreased 6 per cent., while those accompanied by complete specifications increased 2·2 per cent. and reached the record total of 9,829. The number of applications from persons residing in the United Kingdom decreased approximately 6·5 per cent., while the number granted to residents in most foreign countries showed increases, with the exception of the U.S.A. (decrease, 5·25 per cent.). A total of 16,452 patents have been granted on 30,603 applications received in 1909, and among 16,269 patents granted in the United Kingdom in 1910, 42·5 per cent. were to persons non-resident on British soil. Corresponding percentages are: U.S.A., 10·5 per cent.; Germany, 30·6 per cent.; France, 53·9 per cent.; Switzerland, 58 per cent.; Austria, 66·6 per cent.

The subjects of the applications continue to form a reliable index to the progress of industry and its conditions, but events of temporary interest give rise to abnormal numbers of more or less relevant patents; thus the Hawes Junction and Pontypridd disasters led to numerous applications covering automatic railway signalling devices. The ever-increasing importance of means of locomotion, and apparatus auxiliary thereto, is demonstrated by the high percentage of applications filed *re* road wheels, variable-speed gearing, clutches, and so on. Internal combustion engines have claimed much attention from inventors, particularly in connection with revolving cylinder and "valveless" types. A large proportion of the aeronautical patents refer to the use of aeroplanes as naval auxiliaries, and hence to the question of rising from and landing on battleship decks. Increasing attention is being given to applications of the gyroscope, *e.g.*, as a substitute for the magnetic compass, and as an anti-skidding and stabilising device for vehicles.

The total receipts of the department amount to £319,711, as compared with £314,024 in 1910, and the surplus of receipts over expenditure is £114,731—an increase of £15,662 on the 1910 figure. During last year, 6,283 volumes were added to the library, making the present total, exclusive of duplicates, 136,000 (44,300 works). The total number of readers registered was 155,091, as against 153,707 in 1910.

An examination of 17,039 complete specifications accepted in 1910 showed 1,181 to be wholly anticipated, 10,352 partly anticipated, and 5,506 not anticipated. Of those anticipated, 10,363 were amended without a hearing and 740 after a decision. The expiry of 15,539 patents in 1911 and the sealing of 17,164, increased the number in force by 1,625. Out of 13,452 patents sealed on applications made in 1898, only 3·9 per cent. were maintained for the full period of 14 years. The Hart, McCulloch, and Lodge patents (extended beyond the normal maximum) expire in 1914, 1918, and 1918 respectively.

During the last 10 years the number of hearings upon oppositions to the grant of patents was 1,316, and among 198 appeals heard by the law officer the decision of the Comptroller was supported in 118, varied in 55, and reversed in 25 instances. In 18 appeals against the results of 72 hearings upon opposition to specification amendments, the Comptroller's decision was twice varied and twice reversed. During the same decade there were 1,217 hearings under Sec. 73 of the 1907 Act, and only one reversal in 26 appeals. Last year there were 36 hearings *re* restoration of lapsed patents, and 4,360 hearings were fixed under Sec. 7 (4), 1907; 1 (6), 1902; and Patents Rule 33, 1908, but 2,381 of these were abandoned or settled by amendment of the specifications.

Municipal Trading in Canada.

We often have something to learn from our Colonial brethren in relation to the supply of electricity. This means of distributing power has naturally found favour in a country where energy can be had for the asking, and where its supply is not, as here, dependent upon the sweet will of the miner, egged on by the leathern-lunged agitator who has to orate for his living. It is satisfactory to find, however, that although the supply of electricity in some of the Dominions is recognised as a public or municipal affair, there is a body of opinion that the supply of fittings, &c., should be reserved for private enterprise.

For instance, the *Hamilton Herald* has recently warned the municipal Corporations against going into the retail business. In the course of its warning it says:—

> **It is natural and right that municipal corporations should have power to supply electric power and light to private consumers on a commercial basis, for the distribution of electric current is in the nature of a natural monopoly, and all natural monopolies should be publicly owned and controlled. The distribution of water is no more a natural monopoly than the distribution of electric current. But the vending of electric fixtures and supplies is not a natural monopoly. We do not think it would be prudent for the municipal corporation to go into business as a vendor of water-taps and washers, of sinks and bath-tubs and other fixtures and furniture in connection with which water is used. And the same is true of electric supplies and fixtures. These things are articles of commerce not subject to monopoly—at least it is not natural that either the production and distribution of them should be monopolised. If the municipal corporation were to go into business as a vendor of such supplies, it would have to compete with merchants and plumbers, and the competition would be unfair.**
>
> **Admit that the municipal corporation may properly buy and sell goods of this sort, and you will find it exceedingly difficult to set bounds to municipal commercial enterprise.**

We might say, with reference to this expression of opinion: "We agree, and have nothing to add."

The journal in question indicates one justification for this form of municipal trading. It expresses the view that if local vendors of fittings made any attempt to refuse to handle electric fixtures and supplies adapted to the kind of power supplied by the municipality, the municipality might then take up the trade for its own protection.

D

THE INTER-RELATION OF CAPACITY IN THREE-PHASE THREE-CORE CABLES.

By A. B. CLARK.

When people make capacity tests on three-phase three-core cables they do not always connect up the cores in the same combination; it is not unusual to hear of widely different values of the capacity given for what is really the same cable.

In what follows it is shown how from two capacity measurements, each of a different method of connecting

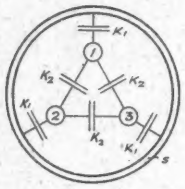
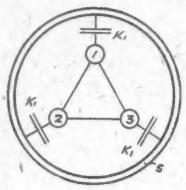


Fig. 1.



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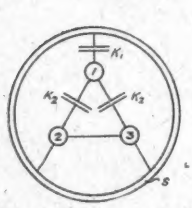


Fig. 2.

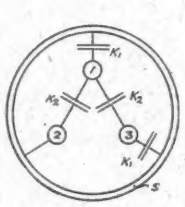


Fig. 4.

up the cores of the cable, all the other combinations can be calculated; thus tests made in various ways can be reduced to a common basis for comparison.

Let fig. 1 represent the section of a three-phase three-core cable, 1, 2, 3 being the cores and s the lead sheath. These cores may be considered as being without capacity, but connected to each other and the lead sheath by means of condensers K_1 and K_2.

It is convenient to make the two capacity tests as follows, but any combination will do:—

1. Make a capacity measurement between core 1 and the other cores 2 and 3 connected to the sheath s; this we will represent by 1‖2.3.s. This is shown diagrammatically in fig. 2; call this x.

2. Make a capacity measurement between the three cores connected together, and the sheath s; this is called 1.2.3‖s, and is shown in fig. 3; call the value of this y.

Now the capacity measurement x is equal to the three capacities, K_1 and twice K_2, in parallel. That is—

$$x = K_1 + 2K_2 \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

The capacity measurement y is equal to the three capacities K_1 in parallel. Then we have—

$$y = 3K_1 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

It follows that $K_1 = y/3$; and substituting this value of K_1 in equation (1) we have—

$$x = y/3 + 2K_2$$
$$\therefore K_2 = x/2 - y/6$$
$$= \tfrac{1}{6}(3x - y) \ldots \quad \ldots \quad (3)$$

As an example from practice, the following test on an 11,000-volt three-phase cable is given:—

Capacity 1‖2.3. s = ·269 microfarad per mile.
„ 1.2.3 ‖ s = ·494 „ „ „
K_1 = ·494/3 = ·1646 microfarad per mile.
$K_2 = \tfrac{1}{6}(3 \times ·269 - ·494)$ = ·0521 microfarad per mile.

Having obtained K_1 and K_2 other combinations may be considered.

Fig. 5 represents the conditions of the capacity of 1 core to the lead sheath; denoted by 1/s, cores 2 and 3 being insulated.

It will be seen that core 1 is joined to the lead sheath by capacity K_1; also by way of cores 2 and 3 by means of capacities K_2 and K_1 in series.

Call the capacity of K_2 and K_1 in series = K. Then—

$$1/K = 1/K_1 + 1/K_2$$
$$\therefore K = K_1 K_2/(K_1 + K_2).$$

Therefore—

$$\text{Capacity } 1\|s = K_1 + 2K_1K_2/(K_1 + K_2). \quad (4)$$

Taking the previous example—

$$\text{Capacity } 1\|s = .1646 + 2\left(\frac{.1646 \times .0521}{.1646 + .0521}\right) = ·2438$$

microfarad per mile.

The capacity obtained for this combination of 1‖s experimentally on the same cable was ·248 microfarad per mile, which is in close agreement with the calculated value.

The combination shown in fig. 6 is that of the capacity between any two cores, denoted by 1‖2; the third core being insulated. In this connection there are three paths between the two cores 1 and 2:—

1. By means of K_1 to the sheath.
2. „ „ K_2 between cores 1 and 2.
3. „ „ K and core 3.

Therefore, by the ordinary rule for the grouping of condensers the capacity of the combination is—

$$1\|2 = K_2 + K_2/2 + K_1/2,$$
$$= \tfrac{1}{2}(3K_2 + K_1) \quad \ldots \quad (5)$$

Taking the actual test case as above for the example, we have—

Capacity $1\|2 = \tfrac{1}{2}(3 \times ·052 + ·1646) = ·1604$ microfarad per mile. The actual experimental value for this cable and combination was ·166 microfarad per mile; again in reasonably close agreement.

Fig. 7 represents the combination denoted by 1‖2.3; that is, the capacity between core 1 and the cores 2 and 3 in parallel.

In this case we have two of the capacities K_1 in parallel, and these are in series with the remaining capacity K_1; also the two capacities K_2 in parallel. The value of the two capacities K_1 in parallel is $2K_1$, and if the value of $2K_1$ in series with K_1 is K, then—

$$1/K = 1/2K_1 + 1/K_1.$$

Therefore, $K = \tfrac{2}{3}K_1$.

Therefore the capacity of this combination is—

$$1\|2.3 = \tfrac{2}{3}K_1 + 2K_2 \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

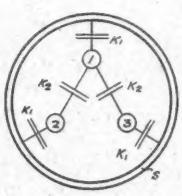


Fig. 5.

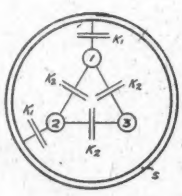


Fig. 6.

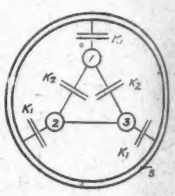


Fig. 7.

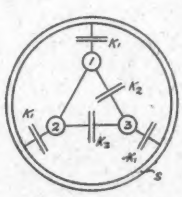


Fig. 8.

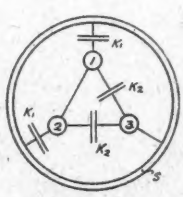


Fig. 9.

Illustrating by means of the example as before—

$$\text{Capacity } 1\|2.3 = \tfrac{2}{3} \times ·1646 + 2 \times ·0521 = ·214$$

microfarad per mile.

The observed value of this combination of cores was found to be ·221.

Fig. 4 shows the combination denoted by 1‖2.s; that is, the capacity between core 1 and core 2 connected to the

sheath, core 3 being left insulated. In this case there are three paths—

1. By means of K_1 to the sheath from core 1.
2. By means of K_2 between cores 1 and 2.
3. By means of K_1 and K_2 in series to the sheath by way of core 3.

Therefore, from what has been said previously, the capacity of this combination is—

$$1\|2.s = K_1 + K_2 + K_1 K_2/(K_1 + K_2) \quad \ldots \quad (7)$$

To illustrate by means of the example as before, we have—

$$\text{Capacity } 1\|2.s = \cdot1646 + \cdot0521 + \frac{\cdot1646 \times \cdot0521}{\cdot1646 + \cdot0521}$$

$$= \cdot2563 \text{ microfarad per mile.}$$

The actual value of this combination obtained by experiment was ·258 microfarad per mile, showing closer agreement than the previous combination.

The last two combinations, shown in figs. 8 and 9, are similar in the fact that the two cores 1 and 2 are joined in parallel, and the calculations are made between these two cores and the sheath; but in fig. 9 the core 3 is joined to the sheath, and in fig. 8 it is insulated.

The condition shown in fig. 8 is denoted by $1.2\|s$; and without going into detail, it will be seen that this capacity is—

$$1.2\|s = 2K_1 + 2K_2K_1/(K_1 + 2K_2).$$

Example as before—

$$\text{Capacity } 1.2\|s = \cdot1646 \times \frac{2 \times \cdot0521 \times \cdot1646}{\cdot1646 + 2 \times \cdot0521}$$

$$= \cdot393 \text{ microfarad per mile.}$$

No experimental test of this combination was made.

Now, in fig. 9 the fact of connecting the core 3 to the sheath makes the expression for this combination, denoted by $1.2\|3.s$, a very simple one; it will be readily seen to be, with reference to fig. 9—

$$1.2\|3.s = 2K_1 + 2K_2 \quad \ldots \quad \ldots \quad (9)$$

Example:—Capacity $1.2\|3.s = 2 \times \cdot1646 + 2 \times \cdot0521 = \cdot4334$ microfarad per mile. The experimental value for this combination was ·435 microfarad per mile.

The experimental determinations of the capacity were made by the usual method of comparison with a standard condenser.

Below are tabulated a few comparisons between the calculated and observed values for various cables:—

Combinations ..	$1\|2.3.s$.	$1.2.3\|s$.	$1\|s$.	$1\|2$	$1\|2.3$.	$1\|2.s$.	$1.2\|s$.	$1.2\|3.s$.	Size.
Capacity per mile.—									
Measured ..	·269	·494	·248	·166	·221	·258	—	·435	37/15
Calculated ..	—	—	·249	·160	·214	·256	·393	·433	"
Measured ..	·255	·49	—	·150	·206	—	—	·390	37/15
Calculated ..	—	—	·223	·155	·206	·238	·348	·397	"
Measured ..	·28	·495	—	·168	·224	·268	—	·440	37/14
Calculated ..	—	—	·25	·168	·225	·265	·397	·445	"
Measured ..	·304	·528	·266	·184	·247	·304	·324	·474	37/13
Calculated ..	—	—	·269	·184	·245	·286	·374	·480	"

Irish Electricians.—In Parliament last week, Mr. Brady asked the Vice-President of the Department of Agriculture (Ireland) whether his attention had been called to the fact that his Department recently advertised for applicants for the position of electricians to the new Royal College of Science in Dublin, and if so, how many Irish electricians applied, and what was the nationality of the succesful candidate?—Mr. Russell, in reply, said that there were 120 applicants for the post, and the candidate who received the appointment was an Irishman.

A Copper Trade Forecast.—According to a statement accompanying the statistics which have just been issued by the firm of Aron Hirsch & Son, of Halberstadt, the prospects of an increase in the European consumption of copper can be regarded as decidedly favourable, and the electrical industry of Germany in particular entertains good expectations in respect of the near future, especially in relation to the conversion of steam railways to electric traction. As far as the United States are concerned, the firm states that it seems as if great expectations of a thorough improvement in industrial branches in 1912 are still premature on account of the impending presidential election. But even if an increase in the stocks of copper should be observed in the current year, it should not be overlooked that this situation cannot last long, as the consumption should soon again exceed the production through the intervention of American industries. In general, the copper industry is held to be justified in good expectations for the early future.

FRAUDULENT TESTS.

[CONTRIBUTED.]

As a contract for any kind of power plant machinery is rarely placed without definite guarantees as to performance and efficiency being demanded, it naturally follows that certain tests have to be carried out with the object of assuring the purchaser that all specified results have been obtained. Upon the satisfactory completion of such tests, usually dignified by the name of "official trials," payment for the plant depends, and as the earning of a bonus or the incurring of a penalty is frequently consequent upon the exact results, to say nothing of the credit of the manufacturer, it follows that the latter has every inducement to secure a favourable record upon the test sheet. The other party to the contract, however, has even more interest in the tests, because, not only will they probably constitute his one and only means of knowing what the efficiency of his plant really is, but any default in performance will be a source of loss or danger to him so long as the plant is in use.

Now, when competition is very keen amongst contractors to secure a particular order, there is an obvious temptation amongst the less scrupulous to claim an exceptionally high efficiency for their products, and to guarantee a better performance than they are likely to obtain, trusting to conceal the discrepancy when the tests are carried out. It is not, however, only in the case of firms giving high guarantees that fraudulent testing is met with, as there are others who habitually resort to such practice because they are incapable of obtaining results which, with better design and workmanship, should be easily secured.

It may be protested that the supervision of tests on behalf of the purchaser should be sufficient protection against deliberate and systematic fraud; but, unfortunately, this is by no means the case. The average inspector is a young man whose previous experience in some consultant's office or Government department has never initiated him into the secrets of the test-bed. Usually, also, the official test is conducted at the manufacturer's works, and the inspector is received with deference and hospitality, so that he does not like to show a suspicion which may be unfounded. Moreover, in many cases, particularly where Government work is concerned, he considers his duty accomplished when he has seen the plant running and noted a few figures before he hurries off to catch his train, relying on the promise that the full result of the trial, carefully worked out, shall be posted on to him that evening. The average Admiralty inspector is often very complaisant in this respect, and thus almost invites the fraud which his simplicity renders possible. If, however, an inspector takes his duties more seriously, he is, as a rule, hopelessly unequal to the wiles of the testing staff, who pride themselves on their ingenuity in deceiving him, and have everything in their favour, even to test-bed equipment specially designed for fraud.

The vast majority of manufacturers in Great Britain, and certainly the whole of the private buyers of plant, would welcome the elimination of fraudulent testing and its consequent evils. But those who know most of the subject rarely say much, either because they are interested in a continuation of the conditions, or because they have natural scruples about casting aspersions on the honesty of their competitors. Hence an exposure of some of the typical forms of test-bed fraud is desirable in the interests of the industry generally, and while it is hopeless to attempt to deal exhaustively with the innumerable methods of deception, a few of the common methods of obtaining official certificates of spurious figures from the unwary inspector will be indicated.

Before dealing with the tricks of the test-bed proper, a few remarks concerning tests of material will not be out of place, as tensile and other tests are frequently specified for important items. Test bars from castings have usually to be broken off from the main casting in the presence of the inspector, who stamps them in order to identify them after they are machined for testing. Even this precaution, however, is futile if the test bars have been previously cast independently of good metal, and by being placed in the moulds, are burned on to the body of the casting whose quality they are supposed to represent. One foundry at least has been credited with this practice, which is very

difficult to detect. A steel test piece has been known to be screwed into the body of the "parent" metal, from which an Admiralty inspector afterwards saw it cut in apparent good faith. The shaft thus gaining approval subsequently broke, with serious results.

Supposing, however, the test specimen to be genuine, the inspector should assure himself that it has not been treated in any way so as to alter its mechanical properties. It is well known, though often forgotten, that the elastic limit of a test bar can be materially raised by stretching the piece previously to its official test. This fraud is sometimes betrayed by the marks made by the grip of the machine at the preliminary stretching, but the artificial strengthening of gunmetal test pieces by annealing is not so well known nor so easily detected. If ordinary Admiralty gun-metal of composition 88 : 10 : 2 is annealed, it gives a higher tensile test, but becomes porous. Now, porosity does not matter in a test bar, so that this can be artificially raised in strength above that of the main casting, to which "heat-treatment" is inapplicable for the reason stated.

Assuming that the test bar is known to be genuine and unsophisticated, and the inspector has assured himself that it is of the dimensions specified, he has then to see that an unfairly high breaking stress is not obtained by a too rapid application of the load. It is unusual for the testing machine itself to be tampered with, though not impossible. Before leaving the subject of tensile tests, it may not be out of place to mention the advisibility of inspectors insisting that a surplus article shall always be provided when the specification calls for a test to destruction on one article of a set, as is often done in the case of connecting rod bolts for high-speed engines. Thus, the inspector can choose a bolt to be tested, and leave the required number for the engine. Otherwise a new one has to be made, and it will probably be made of the handiest material, without regard to quality.

Hydraulic tests are specified for many castings, the object being to prove that the articles are not porous, and are capable of standing a stipulated internal pressure. Porosity in iron castings is usually concealed by rusting up the bad places with a solution of salammoniac. Sometimes a cored place is filled instead with an acid solution of copper sulphate, metallic copper being thus deposited on the iron surfaces. The deposit may be localised and thickened where desired by placing small pieces of zinc to serve as anodes. When the deposit is considered sufficient, the hydraulic test is applied, and the copper, being forced into the spongy iron, renders it quite watertight. Light peening with a hand hammer will often cure mild cases of porosity. In the case of bronze castings—such as those for pumps or air compressors—soft solder is frequently applied; but the use of boiled oil is quite as effective, and less easy of detection. The oil is forced into the metal by the test pump, and soon oxidises and hardens, making the casting perfectly able to withstand the water test. None of these ways of getting spongy castings through the hydraulic test is, however, so flagrant as the plan of blanking off the casting from the pump, so that while the gauge at the latter shows a high pressure, the interior of the casting is subjected to no pressure at all. Sometimes a blank flange across the pressure pipe, close to the casting, is used, but more often a small valve in this pipe is surreptitiously closed. A pressure gauge communicating with the interior of the casting is the best preventitive of fraud of this kind. It is well to assure oneself that the gauge actually does communicate with the interior, as boiler tests have been conducted with a pipe inside the boiler connecting the gauge with the pump inlet. The boiler was full of water, so that had the manhole cover been removed, it is probable that no suspicion would have been aroused.

Coming now to tests of plant as a whole, it will be best, perhaps, to consider the tricks practised upon the inspector in the case of a particular plant, such, for example, as a high-speed engine direct coupled to a dynamo for electric lighting. It will be assumed that neither the engine nor dynamo could fairly obtain any one of the guarantees, and that the test-bed staff have instructions to get the plant through its tests with especial credit by any means in their power. We will consider first the six hours' full load test to determine the steam consumption of the engine and temperature rise of the dynamo. In testing Admiralty engines and commercial engines where saturated steam conditions are specified, the steam consumption may be reduced by 10 or 15 per cent. by the use of quite a modest amount of superheat. A thermometer pocket at the stop valve is never specified for such engines, so that even if the inspector suspects superheat he has no means of verifying it, as a thermometer in contact with the outside of the pipe is not much good. A visit to the boiler house will not give him much information, as little must be inferred from the position of the lever of the superheater damper or the handle of the mixing valve. As a matter of fact, the Admiralty inspector never does suspect. The stipulation of a proper thermometer pocket at the stop valve is the best safeguard against surreptitious superheat. In engines, and particularly in turbines, built for superheated steam, where there is such a pocket, the ingenuity of the tester is often applied to the vacuum gauge. An inch, or even half an inch of vacuum, will make such a marked difference in steam consumption, that any test conducted with an apparently poor vacuum and "corrected" to the specified conditions may reasonably give grounds for suspicion. The inspector should rely on his own vacuum gauge, and should not accept the readings of any works recording aneroid barometer or "weather glass," as necessarily giving an accurate indication of the barometric pressure, as these may be adjusted with the greatest ease.

Besides "faking" the steam and the vacuum conditions, there are however numerous other ways in which the steam consumption can be made to come out on the right side of the guarantees. Neglecting such obvious but common expedients as running water out of the measuring tank during the test, we may mention the device of falsifying the ammeter readings by tampering with the shunt, or using leads of lower resistance than those with which it was calibrated, or otherwise. These methods, even if detected, can usually be explained away to the satisfaction of the average inspector. They have some popularity, since they have the advantage not only of reducing the apparent steam consumption per KW.-hour, but of easing the load on the engine and lessening the heating and sparking of the dynamo. Occasionally an engine is built which will not develop its rated load or overload with the stipulated steam pressure. In such a case, unless, unknown to the inspector, it can be supplied with steam at a higher pressure, there is every temptation for the testers to falsify the ammeter in order to get the plant through its test. After the inspector has left, the high-pressure slide valve is removed and some of the lap turned off, so as to get the requisite power, though at the expense of economy. To guard against falsified or specially calibrated instruments, the Admiralty inspector should bring his own portable testing set and connect it up himself. He should also never leave the plant unwatched, for while he is lunching with the heads of the firm during the six-hours' test, he may be sure that the load is off the machine, and that scouts are posted out to notify his return.

As regards temperature tests, there is little to be said. Temperatures are usually taken by the thermometer, and an experienced tester will have no difficulty in getting the machine through, even if the temperature has not been lowered by running at less than the rated load, as by any of the means previously indicated. Unless the inspector places the thermometers himself, and sees that they remain untouched until he himself reads them, he should distrust the figures given him. Moreover, he should see that the thermometer placed to measure the temperature of the surrounding air is not put "for convenience" on the top of the outboard bearing or near a hot steam pipe. He should also be conversant with the fact that there are in existence thermometers reading several degrees low, and that these are not unknown adjuncts to the equipment of a test bed.

Few tests are more difficult to conduct with accuracy than those of air-compressors, but the usual official trial makes no pretence to scientific exactitude. In general a machine is merely required to give evidence that it will deliver the guaranteed output. The output is tested either by noting the time taken to pump up a reservoir of known capacity to the stipulated pressure, or by requiring the compressor to maintain a given pressure when the air is escaping through a sharp-edged orifice of known size. In both cases the temperature of the air in the reservoir should be noted, and, it

is needless to say, this cannot be measured by holding a thermometer in the issuing jet, when the orifice method of test is used, although this is sometimes done by Government inspectors. When the reservoir test is being conducted, the usual method of fraud consists in having a quantity of water in the reservoir, thus reducing its capacity and shortening the time required to raise the air it contains to the specified pressure. The presence of water cannot easily be detected if the drain cock is fitted with an internal pipe terminating at a point above the bottom of the reservoir, so that air is always drawn from the cock when it is opened. Another method, largely practised when there are duplicate reservoirs, as in battleships, consists of slightly opening a junction valve for a few minutes and allowing air from another reservoir to enter the one to which the compressor is connected. By this means the compressor is helped to the desired extent, and if the trick is carried out unobserved, it is difficult of detection, as the gauge readings are not fine enough to make the transaction readily visible. When the output of a compressor is being gauged by the pressure maintained behind a sharp edged orifice, it is the duty of the inspector, not merely to measure the orifice, but to satisfy himself that there is no obstruction, temporary or otherwise, to the free flow of air to the orifice.

(*To be concluded.*)

PROCEEDINGS OF INSTITUTIONS.

The Supply and Transmission of Power in Self-Contained Road Vehicles and Locomotives.

By J. C. Macfarlane, M.I.E.E., and H. Burge, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *London, February 22nd*, 1912.)

At the present time the popular means of driving heavy commercial vehicles in this country is by the petrol engine, and this is fairly satisfactory where long non-stop runs have to be made through level country. In large cities, however, the problem is entirely different. The inflexibility of the petrol engine makes it a difficult matter to design heavy vehicles to withstand the continual starting and stopping that is necessary in city traffic; this necessitates a large engine, three to four times the size that would be required to drive the vehicle on the level, which, when running at high speed and developing low power, must be very inefficient. Other disadvantages of the petrol engine for this service arise out of the multiplicity of parts liable to get out of order, and omnibus companies require a large night staff for continual observation and adjustment. As regards the petrol omnibus in London, the transmission gear is the most expensive item in the upkeep.

The authors have no doubt that the remedy lies in adopting secondary batteries as a source of power for heavy vehicles of all kinds for city traffic, more especially if complete regenerative control is adopted and the batteries are maintained by the makers.

The reasons for this are briefly as follows:—

1. The absence of shock and vibration greatly reducing the wear and tear.

2. The reduction of rates following on the supply of current for battery charging from municipal stations.

3. From the owner's point of view there are many advantages, some of which are: Lower cost of insurance and freedom from insurance limitations; instant readiness of vehicle and less depreciation, resulting in less time in the repair shop, so that a larger percentage of vehicles are kept running. This involves a reduction in capital, rates, rent and taxes, insurance, supervision and establishment charges. In the case of omnibuses, due to better lighting and other public advantages, the takings are bound to be considerably augmented, and further additions to revenue might be obtained from novel forms of advertisement and electric signs on the vehicles.

Even if the supply is cheap, the income to be derived by stations will be nearly all profit. Taking energy at ½d. per unit, 1,500 electric 'buses running in a city, each consuming 1 unit per mile, and making 30,000 'bus-miles per year, would provide an income for the power station of £100,000 per annum, apart from the additions to the lighting load that would naturally accrue. Surely this is well worth fighting for, seeing that it is obtained with practically no outlay.

Hitherto traction batteries for a 6-ton vehicle have weighed about 2 tons (consuming energy at well over 1 unit per mile, *i.e.*, 2 units per mile for charging purposes), and it was therefore impossible to construct omnibuses carrying a sufficient number of passengers to be remunerative. One of the objects of this paper is to describe a system which, to a great extent, removes the weaknesses of the battery and considerably strengthens the position of the battery vehicle from other points of view.

Most of the improvement has been obtained by raising the vehicle efficiency, with a consequent reduction in the size of the battery for a given mileage. Resulting from this, the initial and upkeep costs are reduced in almost direct proportion to the reduction in the size of the battery, but more important still, the ratio of the live to the dead load has been increased almost as the square of the reduction in battery weight.

Some of the methods that the authors have adopted to bring about this result comprise:—

(*a*) Braking entirely by regeneration, the battery absorbing the energy returned.

(*b*) A controller in the shape of a very efficient rotary transformer or automatic electric valve (only transforming half the power supplied to the wheel motors) which automatically limits the current that can be drawn from or returned to the battery, displacing the usual series-parallel type of controller.

(*c*) A motor with special shunt field windings, having a torque-speed characteristic similar to a series motor.

The battery is used under very favourable conditions indeed, and the regenerative action of the motor comes into play whenever the driver reduces the speed or stops the vehicle.

The scheme as applied to the driving of heavy electric vehicles is shown in fig. 1. The automatic electric valve A B, used as a controller, possesses the further property of acting as a power-limiting device between the battery and the motor. The action of this machine under full-speed conditions is as follows:—

The upper half A of the armature acts as a motor, and is coupled directly across the battery. The lower half of the machine marked B acts as a generator, and is coupled in series with the driving motor C, so that the latter is receiving across its terminals twice the battery voltage. The motor C is provided with two shunt field windings, one of which D is connected across the battery, providing a constant excitation, and the other E across the terminals of B. The winding E is arranged so as to assist the winding D during the acceleration period, and to oppose D when running at full speed. The part B of the electric valve is provided with a variable and reversible excitation by the winding F and controlled by the regulator G. When the regulator arm is over to the right, say, B adds its voltage to that of the battery, but when

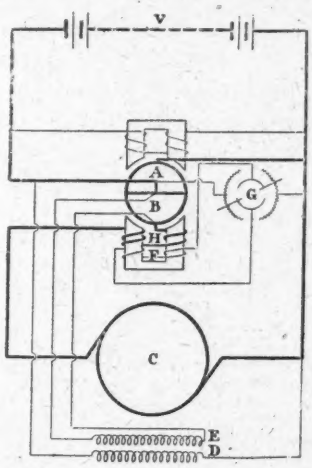


Fig. 1.—Diagram of Connections. (Battery Vehicle.)

the regulator arm is to the left, this voltage is subtracted from that of the battery. With the regulator arm in the mid-position, B is not excited. An additional winding H is also provided on the field of B in series with the driving motor C, which opposes the winding F when B is acting as a generator delivering power to C.

The advantages of this arrangement are as follows: During the period of negative acceleration, when the motor is returning energy, the field of the motor is strengthened so that the electrical braking tendency is largely increased, whereas when the motor is being accelerated and is rotating rapidly, its field strength is diminished so that acceleration is facilitated. The design of the motor is such that due to the action of the field winding B the torque produced is nearly proportional to the square of the current passing through the motor armature. Thus, when starting or hill-climbing, with the controller "full on," the torque is four times that on the level, with only 2½ times the normal current in the armature. Moreover, by means of the series winding on B the current to the motor C is always kept within safe limits when it is driving as well as when it is braking.

The entire control is carried out by means of a foot pedal and a single reversing lever, which is also employed to start up the machine A B. The pedal controls the reversing field regulator G, and when in the "off" position, the arm is over to the extreme left, and if it is allowed to come quickly to this position, a very powerful braking effect is produced, which continues even after the vehicle has been brought to rest. The latter effect is obtained by arranging the resistance of the regulator G so that B gives a back E.M.F. slightly in excess of the voltage of the battery, producing a negative current of no power through the armature of the driving motor, and giving a torque in the backward direction. This torque is arranged to be of such a magnitude that it holds the vehicle on a comparatively steep downward gradient, and yet has not sufficient power to cause the vehicle to start backwards on the level. If, however, the vehicle is facing uphill with the controller in the "off" position, it is necessary, in order to prevent

the vehicle from moving backwards, to depress the controller pedal slightly and give the driving motor a positive torque, tending to drive the vehicle uphill. This torque can be arranged to keep the vehicle stationary on the hill, thereby dispensing with the use of any mechanical brakes.

A vehicle equipped with such a system has the advantage that the speed is adjusted automatically to the gradient of the road. In fact, the speed is a definite function of the torque required to drive the vehicle. The above statement applies to all positions of the controller pedal, as indicated in fig. 2, where the dotted curves

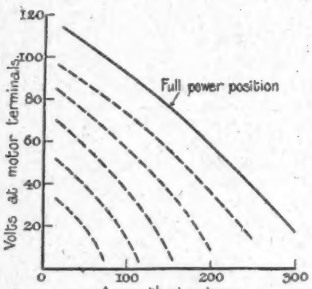


Fig. 2.—Output Characteristic of Rotary Transformer for Various Positions of Controller Pedal.

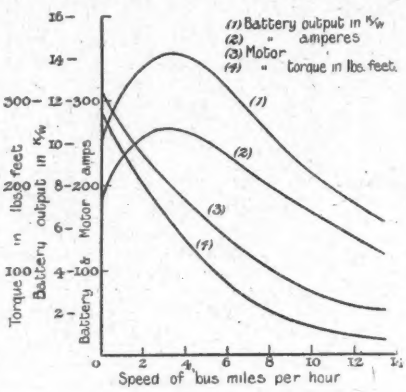


Fig. 3.—Battery Vehicle Characteristics.—Controller Pedal "Full On."

show the output to the motor for intermediate positions. Fig. 3 shows the electrical characteristics of the system for maximum power position of the controller as a function of the vehicle speed.

Due to economical acceleration, regeneration, high torque per ampere, and other causes, it is possible to obtain a higher efficiency, and therefore reduced battery weight and size (*i.e.*, about half the energy consumption and weight for the same number of passengers and mileage as on previous battery omnibuses).

Further, as the voltage of the battery is only half that of the motor, the number of cells can be reduced without additions to the weight of other parts. This admits of a further reduction in the weight, due to fewer cases and connections, less liquid, &c. Also, as the discharge rate of the battery is limited, the capacity is greater under working conditions, *i.e.*, the ampere-hour efficiency is high. Further, it is obviously not necessary to use two motors or a double-commutator driving motor to obtain economical speed control; therefore a further increase in the efficiency of the system is obtained.

Thus the energy, initial and upkeep costs are reduced, and the ratio of live to dead load is very much increased.

The control is very simple, the whole operation being effected with one foot-pedal. It is fool-proof, and any prearranged maximum battery currents are obtained for definite vehicle speeds. These values cannot be exceeded by any means within the power of the driver. Pressing down the pedal increases the speed; raising the pedal reduces the speed, and at the same time applies regenerative braking.

The acceleration or retardation is proportional to the rate of forcing down or raising the pedal, and these have been arranged as a maximum to get up speed from a standstill in about one and a half or two bus-lengths, and to brake to a standstill from full speed in the same distance. Any intermediate positions of the pedal give intermediate speeds, and continuous crawling can be done at the rate of one-hundredth of a mile per hour if required.

One brake can be dispensed with if police regulations permit, and it is not even necessary to use any mechanical brake when driving in the ordinary course.

The system of braking reduces the tendency to skid on greasy roads, and as the controller always returns to the braking position, this action brings the vehicle to a standstill if anything happens to the driver.

An omnibus constructed at Chelmsford and equipped with the system outlined above is now running in London, and conforms in all points with the Metropolitan Police Regulations, and when loaded it has a total weight of not more than 6 tons. It is fitted with a battery having a capacity of 500 ampere-hours on a 5-hour discharge rate. The battery of 28 cells weighs 19 cwt., and the battery case 2 cwt.; the electrical equipment complete weighs 7 cwt.; the total dead weight is 73½ cwt., and the total live weight, with 34 passengers, driver and conductor, is 45 cwt., making in all 118½ cwt. The battery is mounted in front in the position usually occupied by the petrol engine, therefore no swinging bolts or clamps are required for its support. Ordinary apparatus in the way of cranes or blocks is all that is necessary to remove the battery and replace it by another. Further, in this position it is much freer from dust and dirt—a point affecting its life—and it is more easily inspected and repaired. In the previous omnibuses running in London the battery was suspended from under the frame and liable to get very dirty, and if any of the connectors on the cells under the chassis gave out in the middle of a journey, it was almost impossible to carry out repairs on the spot.

Fig. 4 shows the outline of the chassis of the latest design of omnibus, to which is fixed the automatic electric valve and motor, all in one case and marked A, B, C. The case is hung to the chassis frame by means of suspension hooks and eyes and is stayed to the sides of the chassis by rods. The motor drives direct through the cardan shaft to the worm-reduction gearing mounted on the usual construction of live axle. The regulator G is fixed on one side of the electric valve, while the starter K is mounted on the other side. The foot-pedal L and the starting and reversing lever M are linked up to the regulator and starter respectively by means of rods, as shown.

The dimensions of the battery over cells when packed closely

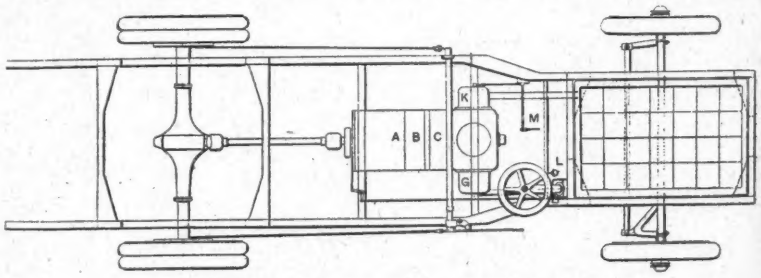


Fig. 4.—Plan of Chassis (Battery Vehicle).

are 49 in. × 31 in. × 16¼ in., making it of a convenient size for placing in front of the omnibus in the position usually occupied by the petrol engine.

The total weight of the equipment, excluding the battery, is extremely small, and compares very favourably indeed with an equipment of the series-parallel control type for the same speed and loaded weight.

Fig. 5 shows a chart of ¼-minute readings of the battery discharge taken on a loaded omnibus (6-ton weight) on a run from Chelmsford, a distance of six miles out and six miles home. There were one or two fairly steep hills to be negotiated, and an examination of the chart will show these, especially the down grades. The

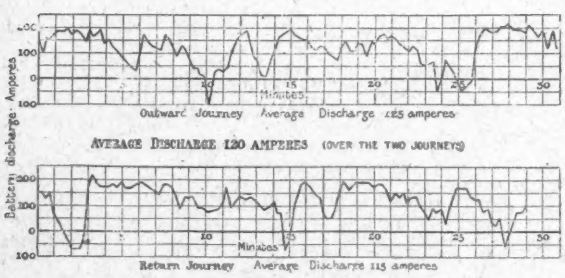

Battery discharge Amperes
Minutes
Outward Journey Average Discharge 125 amperes
AVERAGE DISCHARGE 120 AMPERES (OVER THE TWO JOURNEYS)
Return Journey Average Discharge 115 amperes

Fig. 5.—Chart of Discharging Currents. (Battery Vehicle.)

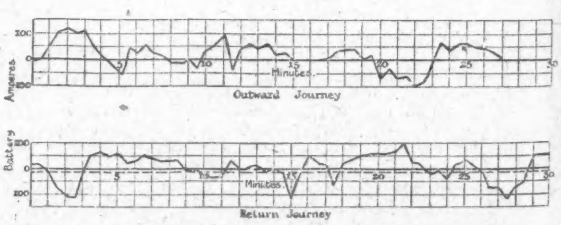


Fig. 6.—Chart of Battery Charging and Discharging Currents (Petrol-Electric Vehicle).

readings were taken with the controller pedal on the "full on" position the whole of the time, the omnibus speed only varying due to the contour of the road. The average speed was just under 13 miles per hour, the average current consumption on the outward journey was 125 amperes and on the back journey 115 amperes, making a total average of 120 amperes. The ampere-hours per mile therefore work out at just under 10, and as there are 28 cells giving a discharge of 120 amperes at about 53 volts, the energy consumption per mile was equal to 0·53 of a unit, or, in

other words, 88 watt-hours per ton-mile, and the average horse-power required to drive the vehicle at a speed of 12¾ miles per hour was just under 8½ H.P. It will therefore be seen that as the battery has an average capacity of 500 ampere-hours, the total range of the vehicle is 50 miles.

It would appear that the electrical omnibus can be run for at least 1d. per 'bus-mile less than the petrol, and the revenue per 'bus-mile should be greater.

The arguments in this section apply equally in many points to heavy commercial vehicles, especially where these are operating in city traffic on round journeys.

It is obvious that the electrical vehicle is unsuitable for travelling long distances or working in outlying districts, but it is suggested that the all-electric system modified by reducing the battery to one-fifth the capacity, and by adding a 9-H.P. air-cooled engine, would meet the case. The engine is coupled to the electric valve, and takes the average load, the peaks being supplied by the battery, which also absorbs the energy returned during braking.

The engine runs practically at constant speed, and has only to supply the average power required to drive the vehicle. Air-cooling for the engine is possible, with its attendant advantages. A governor is used to keep the engine speed constant. The load factor being approximately 100 per cent., the consumption of petrol will not be more than half that of the ordinary petrol vehicle, the engine of which works on the average at only one-third full power.

Due to economical acceleration, high torque per ampere, and regeneration, the efficiency of the system is very high, and also one mechanical brake can be dispensed with. The weight is under that of the petrol omnibus.

Fig. 6 shows a chart of the charge and discharge of a buffer battery, and was obtained by fitting a petrol engine to the chassis of the electric 'bus described above, and running the vehicle over a road of average contour. The engine has supplied the average load of the omnibus throughout a 12-mile journey out and back, and the hills have been dealt with by the battery. The dotted straight lines gives the average value of the complete discharge that the battery obtained during the 6-mile inward run; this was about 17½ amperes, although the maximum went up in some cases to 110 amperes. The vehicle would travel approximately 14 miles with a gallon of petrol, making a cost of 0·75d. per mile for power, taking petrol at 10½d. per gallon.

It would appear that the petrol-electric vehicle, constructed on the above lines, would cost less to run than the present vehicle by at least 1½d. per mile.

Many railway companies have been looking into the question of electrifying their suburban lines, to meet more successfully the competition of tramcars and omnibuses. It is suggested that a self-contained electric train with complete regenerative braking would meet the case. The capital outlay apart from the cost of a generating station would only amount to approximately two-thirds of that required where the power has to be transmitted from generating stations and fed to the train by conducting rails.

The trains would be made up of any number of motor coaches and trailers on the multiple-unit system. The motor coach is equipped with a spirit or oil engine and electrically equipped similar to that described, but to provide in suburban trains the very large additional power required during acceleration, and to absorb the returnable energy, a larger proportion of battery is carried on the train.

Only a comparatively small engine is required, developing power sufficient to overcome all train friction, battery, and other losses, and running at constant speed and power throughout the whole journey.

So far as can be seen from estimates, the capital outlay would be reduced to approximately two-thirds and the cost of running to seven-eighths, reductions which should make the system proposed well worth consideration where capital is scarce and where there is likely to be a narrow margin between revenue and total working costs.

The Ignition of Coal Dust by Electric Flashes.

By Prof. W. M. Thornton, D.Sc., D.Eng.

(*Abstract of paper read before the* Association of Mining Electrical Engineers, North of England Branch).

This paper deals with an experimental investigation of the influence of the presence of firedamp on the ignition of clouds of coal dust by single electric flashes. Previous experiments dealt with the influence of small percentages of ordinary lighting gas upon the ignition of clouds of fine coal dust in air by single electric flashes. The degree of ignition was there found to depend very largely upon the manner of formation of the cloud.

Instead of the Ralph electrical device for indicating the percentage of coal gas present, which, though perfectly adapted for detecting coal gas, is not sensitive in methane, the desired strength of mixture was now obtained by introducing measured volumes of gas into the explosion vessel, the volume of which had been accurately determined. A blast was made by fitting the rubber bag of a motor-cycle horn to the dust bottle; the expanding jet of dust produced by it crossed the explosion box over the arc and impinged upon the closed end of the exit, forming in the box a dense cloud more uniformly distributed and with less movement than before. This new arrangement gave a marked increase in the sensitiveness of the cloud to ignition. No change was made in the electrical conditions, the arc being that caused by breaking 4·5 amperes of non-inductive direct-current at 480 volts as quickly as possible.

The first conclusion to be drawn from a comparison of the figures obtained was that the presence of gas had a greater effect when the disturbance of dust and air was not violent. Again, in the former case, the transition from the slow rate of change at very low percentages of gas to the linear rate of change obtained at values approaching 1·25 per cent., was more gradual and had a clear turning point at 1 per cent. In the present case the linear stage continued with both lighting and marsh gas down to 0·5 per cent. The slope of the curves at points corresponding to 1·5 per cent. of gas showed an increase in the former experiments of about 12·0 ignitions for unit percentage increase of gas, and in the present 11·5. The fact that the curves obtained by the two arrangements are parallel was a satisfactory confirmation of the experimental results, showing that the influence of the gas was the same in both cases, and that the difference was caused by the manner of forming the cloud of dust and the disturbance of the air in the box.

The influence of methane was uniformly less than that of lighting gas in the ratio 0·92.

Discussion.

Mr. H. W. Clothier said that this paper was intended as a reply to criticism which had been levelled at Dr. Thornton, because he had not tested the explosive properties of coal dust and methane.

Mr. T. A. W. Smith said he thought the question of temperature would be found to have considerable influence on the results obtained; it was a curious fact that fiery mines were always exceedingly hot.

Mr. H. W. Clothier said that although some of the figures given by Dr. Thornton might appear to be alarming (*e.g.*, 60 per cent. of full ignitions could be obtained with 1 per cent. of fire-damp in a cloud of coal dust) it must not be forgotten that these were obtained with the utmost difficulty, and he thought that the chances of the same conditions occurring in a mine were exceedingly remote. It was, however, satisfactory to note that no coal dust explosion in a mine had ever been proved to be due to electricity.

Electric Haulages in Mines.

By W. C. Mountain, M.I.E.E.

A lecture was given by Mr. W. C. Mountain on January 15th, 1912, before a joint meeting of the Institution of Electrical Engineers (Newcastle Local Section), and the Association of Mining Electrical Engineers (North of England Branch). The author explained that main-rope haulage consisted of a single drum, hauling the tubs up a single road, and was used in places where the gradient was sufficient to allow the empty tubs to run back and draw the rope with them. It was found that to operate such a system the gradient must be from 2 in. to 3 in. per yard. In main-and-tail haulage a main drum and its rope were used to draw out the train of tubs, a tail rope attached to the back of the tubs being drawn off the tail drum as the full train was hauled out-bye. The train of empty tubs was then drawn in-bye by means of a tail rope.

The endless-rope system was used in mines where the roads could be made wide enough to accommodate two lines of rails, the full tubs coming out-bye along one line, and the empty tubs returning from the pit bottom or running in-bye along the other line. In this system of haulage the rope wheel ran practically continuously, and the speed of haulage was usually about two miles per hour.

The great advantage in this system of haulage lay in the fact that the tubs were delivered in constant rotation to the pit bottom. The load was, therefore, practically constant. On account of its low speed, this system of haulage did not throw up the cloud of coal dust which was frequently the case when hauling at the high speed necessary with main-rope and main-and-tail systems. Less coal dust was also made in the tubs. The wear and tear of the ropes and the tubs was also much less.

There was a large field for the use of portable haulages of either type in collieries, where it was desired to dispense with horses and work as economically as possible with electricity. He had prepared two tables which he had found of very considerable value for ascertaining the horse-power necessary. These tables were based on the assumption that the frictional loss to overcome the friction due to the rope, tubs, guide pulleys, gearing, &c., also acceleration, was equivalent to hauling the load up an incline of about 2 in. to the yard. This figure he had found after many years' experience to be quite reliable and on the safe side, and this would explain what was meant in the tables by "actual" and "virtual" incline.

Table I dealt with the horse-power required by the main-and-tail haulage at 10 miles per hour. The horse-power did not involve any consideration for the length of road.

Table I.—H.P. required for Main-and-Tail Haulage at 10 Miles per Hour.

Actual incline in inches per yard.	Virtual incline in inches per yard.	Load in tons. 5	10	15	20
0	2	16·7	33·3	50	66·6
2	4	33·4	67·5	100	134
4	6	50	100	150	200
6	8	66·3	133	200	267
8	10	83·5	166	250	333
10	12	100	200	300	400

Table II.—H.P. required for Endless-Rope Haulage on Road 1,000 yds. long.

Output in lb. per minute. 200	400	600	800	1,000
1	2	3	4	5
2	4	6	8	10
3	6	9	12	15
4	8	12	16	20
5	10	15	20	25
6	12	18	24	30

In endless-rope haulage one had to consider the weight of coal only delivered per minute either to the pit bottom or landing, also

the length of road and average gradient. Table II had been prepared on the assumption that the road was 1,000 yds. long, and the horse-power would be proportionately reduced or increased as the road was longer or shorter.

In both systems it was desirable to add, say, 25 per cent. to the calculated power for contingencies, such as tubs coming off the road, abnormal friction, &c.

With regard to the construction of haulage gears, bedplates required to be very stiff, so that there would be no springing and consequent vibration. They were generally built of rolled-steel girders or channels placed back to back, the main girders being tied together by cross-girders with strong gusset plates at the corners. The bedplates must be constructed so that they could be taken to pieces for getting underground and in-bye. Care must also be taken that the supporting girders were of such a length that they could be got down the shaft and round corners.

The main shafts should be of steel, and in all cases where machine-cut helical gearing was used, it was desirable that there should be a bearing on each side of the spur wheel and the pinion, otherwise any wear and tear upon the bearing brasses would throw the wheels out of gear and tend to cause noise and heavy wear and tear. The shafts required to be of very ample strength, particularly in main-and-tail haulage gears where the drums were necessarily some distance apart, giving a long distance between the bearings. It was preferable to avoid feathers in clutches. In the case of main-and-tail haulage gears the clutch should slide upon a square or hexagon, in preference to keys or feathers.

The drums of main-and-tail haulage gears should in all cases be in halves where the diameter of the drum exceeded 2 ft. 6 in.

The bushes for drums should be of gun-metal in halves, arranged so that by slackening the bolts the bushes could be drawn back and new bushes fitted without having to take off the drums themselves.

The brake rims should be preferably cast separate from the drums in large sizes, and should be fitted with renewable brake tracks, these usually being secured to the brake rim by countersunk bolts.

The most powerful brake was that known as the "post" type, consisting of two vertical posts working upon fulcrums below the drums. These posts were drawn together by means of a toggle joint, and adjusting screws must be provided to enable the wear and tear of the brake-blocks to be taken up. The brake-blocks were usually of cast-iron, and they could be lined, if required, with hard wood or with material known as "Ferodo," which had great lasting properties, and did not fire.

Double-helical machine-cut gear wheels were by far the best type of gear for transmitting the power from the motor to the main drum-shaft of either endless-rope or main-and-tail gear. With cut teeth double-helical gear would give a reduction of as much as 16 to 1, but a very good proportion was about 10 or 12 to 1. For haulage gears of, say, 100 to 300 H.P. a motor speed of 300 to 400 R.P.M. gave very satisfactory results.

In endless-rope haulage the rope wheel if above 4 ft. in diameter should be in halves with planed joints, and, if a fleeting wheel were used, the rim should be fitted with renewable chilled cast-iron "C" segments.

It was frequently desirable to convert existing haulage gears to electric driving, and in many cases they were not of modern design. Under such circumstances there was no doubt that a drive by ropes from the motor on to a rope wheel on the pinion shaft possessed considerable advantages, and the loss in friction on the ropes was exceedingly small. If the ropes were of proper diameter and sufficient in number, the life would be very long and the upkeep trifling.

In the early days before controllers were as reliable as they were to-day, he had used friction-clutches on both main-and-tail drums and endless-rope wheels. They were satisfactory. Recently, however, very considerable advances had been made in the design of oil-filled metallic controllers and also liquid controllers, and, therefore, on main-and-tail haulages, ordinary jaw clutches could be used.

A large number of interesting lantern slides were shown.

A discussion took place on Mr. Mountain's paper on February 12th.

Mr. F. O. Hunt said that the portable haulage sets described seemed to be a step in the right direction, as they brought mechanical handling of material closer to the coal face. Their advantages, however, must depend upon the facility with which they could be moved, and upon the method of fixing and the arrangements for extension of length. Controllers on haulage motors had to work under very arduous conditions. The liquid type, which was operated by allowing water to flow in and out of the tank, had the great advantage of having a fixed speed of operation independent of the operator.

Mr. H. J. Moysey said that the powers for endless-rope haulage given by Mr. Mountain were lower than he had been accustomed to use. It was important that the figures should be got out, not for the tubs running at full speed, but for starting conditions, and he thought that, in many cases where motors were said to be too small, the trouble lay in the enormous current required to start.

Mr. J. E. F. Leebetter agreed that three miles per hour was quite fast enough for endless-rope haulage, and that this type was the cheapest in upkeep, &c. He said that girder frames should be filled up solid with concrete to form the best foundation.

Mr. T. A. W. Smith favoured the use of flexible shaft couplings, and had found these a cure for broken commutator connections.

Mr. A. Barker thought that frames were better constructed of cast-iron, built up in segments pinned together. Frames which allowed of any spring were a fruitful source of burnt-out rotors. He strongly advocated the bringing out of the neutral point of stator windings, and thought that English manufacturers might follow Continental practice in this respect, as it facilitated testing.

Mr. H. J. Fisher agreed that girder frames were liable to spring, and thought that the motor and its bearings at least should be on a separate cast-iron bed-plate. This was of special importance where the slip-rings were overhung and liable to chatter. He favoured the liquid type of controller as being more efficient, cheaper and lower in maintenance cost.

Mr. H. K. Trechmann said that one great disadvantage of metallic controllers lay in the liability of the nuts on grid resistances to work loose, and this might give rise to dangerous sparking.

Mr. H. W. Clothier said when comparing the relative costs of metallic and liquid resistances the cost of pumping the water should not be overlooked, as this would form a large item in the case of a frequently-operated controller.

Mr. H. L. Riseley criticised the usual design of split bearing. This was usually split on the horizontal axis, and it was difficult to take up wear in consequence. He thought that if bearings were split along the vertical axis they would be much more easily adjusted.

Several other members also spoke.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Simplex Electric Irons for Laundries.

Fig. 1 shows a new type of electric iron which is being put upon the market by Messrs. Simplex Conduits, Ltd., of Birmingham and Charing Cross Road, London, W.C., and is designed specially to

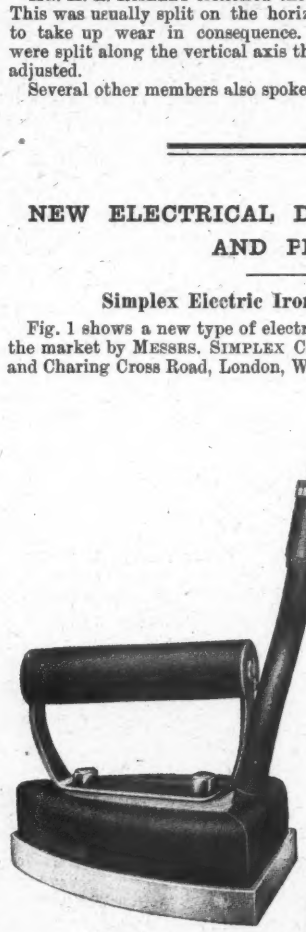


Fig. 1.—Simplex Electric Iron.

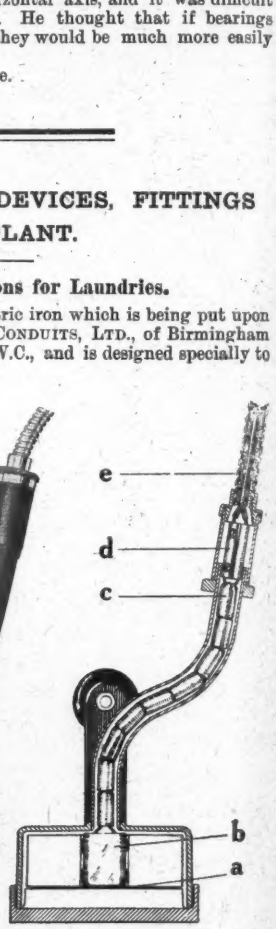


Fig. 2.—Sectional Diagram of Protecting Device.

comply with the severe conditions which obtain in laundries and dry-cleaning shops. It is fitted with a special attachment arranged in such a manner that the combustible insulating covering of the

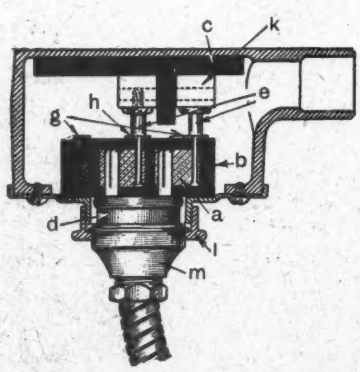


Fig. 3.—Section of Swivelling Connection.

flexible lead is protected at those points which are likely to become very hot, and thus to damage the insulation. This is one of the most troublesome forms of breakdown. Fig. 2 is a sectional diagram showing the construction of the iron; *a* represents the heating ele-

ment, from which two wires are brought into a porcelain connector *b*, which consists of two solid brass terminals embedded in porcelain, the wires being held in position by set screws, without soldering; to these terminals at the top are connected two copper wires, which are carried in iron tubing and insulated by being threaded through small pieces of porcelain *c*, which abut closely together, so that there is no possibility of the two leads accidentally short-circuiting. They form practically a continuous length, one end being convex so as to fit into a concave end on the piece of porcelain immediately succeeding it. These two copper wires terminate in a second connector, *d*, to which the flexible lead is attached; this second connector is enclosed in a coupling piece with a brass cap which may be easily unscrewed, so that the connections are readily accessible.

This arrangement is primarily designed for use with flexible metallic tubing *e*, but the iron may be used in the ordinary way if so desired.

Another source of trouble is the destruction of the flexible through the continual twisting of the iron and therefore of the flexible. Fig. 3 shows in section a patent revolving connection-box designed to overcome this difficulty and made to work in with the special iron described. It is designed to be used where flexible metallic tubing is employed as a mechanical protection to the flexible leads.

In the diagram, *a* is a brass connection piece into which the two pins of a standard two-pin wall plug are inserted; *b* is a rotatable insulating piece enclosing these two connection blocks, on the under side of which are two concentric contact pieces, *g* and *h*, connected to the connection block *a*, into which the two pins of the plug *d* are inserted, and to which the leads to the portable apparatus are connected; *k* are the terminal connection blocks for the circuit wires, which carry two spring plungers, *e*, which press against the concentric pieces *g* and *h*. These contact blocks, *k*, are carried on an insulating piece, *c*, attached to the bottom of the iron box, and separated by an insulating fillet; *m* is a brass cap fitted to the two-pin plug *d*, which carries a split gripping bush, to which is attached the flexible metallic tubing, enclosing the leads to the portable apparatus; *l* is an internally screwed ring which, while allowing the cap *m* (and, therefore, the two-pin plug *d* and insulating piece *b*) to rotate freely, securely attaches it to the iron box. Ample provision is made for the earthing of the iron. The appliance, when supplied complete, is wired with three-wire flexible, and the iron is earthed by means of the third wire to the brass cap of the plug *m*. As the box is an integral portion of the conduit system, the iron is thereby effectively connected to earth.

In the accompanying fig. 5 we show a type of wrought-iron fittings for outside use, which is being supplied by Messrs. Simplex Conduits, Ltd., for several important orders, their destinations including a well-known theatre in the West End of London.

A Portable Drying Oven.

The necessity of some simple means of drying and baking which is free from complications, enabling it to be used by the ordinary workshop assistant, has led Mr. H. W. Turner to introduce an oven designed to give an economical and efficient means for drying armatures, field coils, transformers, insulating materials and electrical work in general. Its external appearance is indicated by the sketch; it consists of a chamber within a chamber, the inner one being intended for the reception of the articles which have to be dried, while the outer one is reserved for combustion gases and fumes. It is heated by gas or paraffin, assisted by waste products from the drying chamber, and an automatic and constant circulation of fresh air through the drying chamber is arranged for. This fresh air, after being heated and dried, is permitted to enter the drying chamber at the bottom, and ascends through the suspended work, carrying with it the volatile fumes from the varnishes. These then pass out of the top, and downward to the bottom of the combustion chamber where they are fed to the flame of the gas bunsen burner, and consumed. In this way the gases assist to raise the temperature of the oven, and after passing spirally round the chamber are allowed to escape by the flue seen in the illustration. In the drying compartment the varnish is oxidised, and the drying process thereby accelerated, the exuding moisture, volatile fumes and gases from the work that is being dried, being rapidly expelled. The combustion chamber in which the gas expelled from the varnished goods is consumed, in order to assist the primary source of heat generation, is surrounded by a walled-in dead air space; this in turn is covered with silicate wool and magnesia, and the whole arrangement is held in position by substantial wooden sheathing and metal bands. The bunsen burner is removable, and may be withdrawn from the oven for lighting purposes, thus avoiding the risk of explosions common to most gas-heated ovens, and the burner flame may be adjusted before it is reinserted in the combustion chamber. Natural draught alone is responsible for automatic circulation of fresh air, and only 6 cb. ft. of gas per hour is required to maintain a temperature in the neighbourhood of 300° F. Obviously, the gas consumption would be less with a lower oven temperature, and an automatic gas regulator controlling the maximum temperature is sometimes attached. A paraffin blow lamp flame shot in the hole in the door will give an equally good effect, so that the oven may be put to work anywhere, even out of doors if necessary.

The size which is usually constructed is 18½ in. in diameter × 36 in. deep, accommodating any armature up to 17¾ in. in diameter, regardless of the length of the shaft. Field coils and other work within these dimensions can, of course, be accommodated also. Varnished goods can be efficiently dried in at least 75 per cent. less time than is usually the case, and the operating cost is very small. With this oven, armatures and field coils may be dried, dipped in varnish and baked without the necessity of transporting the parts out of the building in which they are located. Armatures and other work less than 17¾ in. in diameter may be baked in this oven within three hours, and when it is remembered that insulating varnishes of the baking variety as a rule require a plentiful supply of oxygen properly to set and harden the varnish, the automatic circulation of fresh air is an advantage which is obvious. Two ovens of the standard size have recently been installed at a big steel works at Shotton near Chester, where the coal strike has proved a blessing to those responsible for the electrical installation as they have systematically overhauled the electrical equipment, drying, dipping the parts in varnish, and baking so that the insulation resistance is now of a very high order throughout the whole plant. Its advantages in practice will therefore be obvious.

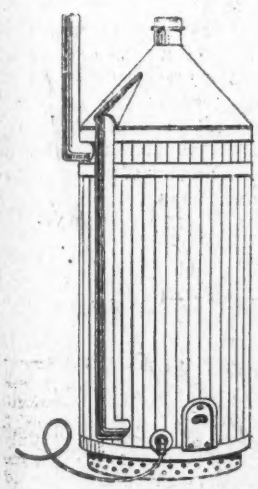


Fig. 4.—Portable Drying Oven

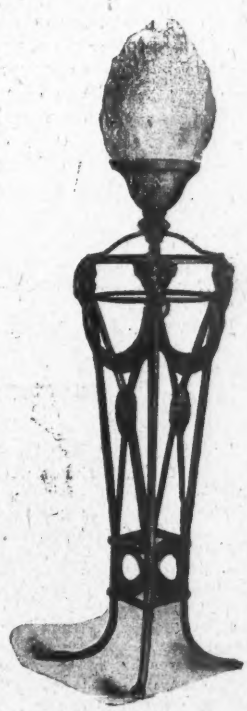


Fig. 5.—Simplex Flambeau.

An Ediswan Lighting Accessory.

In many cases cost of wiring is undoubtedly an obstacle in the way of electricity becoming "the poor man's light." With a view to helping in reducing this cost a new combined ceiling rose and pull switch has just been placed on the market by the Edison and Swan United Electric Co., Ltd., of 36-37, Queen Street, E.C. It is claimed that by the use of this fitting a considerable saving can be effected in the cost of installation, and in many instances the contractor will be able by its aid to install the electric light in rooms where otherwise it would not be adopted, by reason of either the expense or the inconvenience of cutting away the walls or decorations to admit of the wires being run down to the switch point. The fact that the switch and ceiling rose are combined in one also effects a saving in spacing in addition to reducing the installation costs. The switch cord may be made to any length, so the fitting will be found useful in bedrooms or nurseries where it can be shortened so as to be quite out of the reach of children. The fitting, which is of polished brass on white porcelain base, is made throughout by the company at their Ponder's End works. A leaflet dealing with the switch has just been issued by the publicity department of the company, and a copy will be sent to any contractor interested.

Reid's Patent Time Switches.

The accompanying illustrations show automatic time switches made by Messrs. F. T. Reid & Co., of 46, Longbrook Street, Exeter. Fig. 6 shows a time switch, and fig. 7 the base for it; it is of remarkably small dimensions, viz., 3¼ in. × 2¾ in. diameter × 2¾ in. deep, including the base; the clock is a fully-jewelled lever, perfectly dust-proof, and runs 14 days with one winding; the base, fig. 7, is fixed in position and wired once for all; there are two renewable fuses, one for each pole. The clock switch is simply slipped on and held in place by the bayonets A, B, and pillar C; the system is absolutely interchangeable, and its small dimensions will permit of its being fixed in most of the present switch boxes in place of the old hand switch. Current is supplied to the spring hour hand G (which is insulated from the clock) by a forked spring connected to socket A; E is a movable metal plate electrically con-

nected to B, to vary the time of "switching-off"; F is an insulating plate, movable to vary the "switching-on." The action is as follows: the spring hour-hand carries a wedge-shaped shoe H, which rises over the insulated plate F and contines to the required period, when it falls by spring pressure on the metal plate, completes the circuit and continues the required period until free from the plate; the hour-hand wedge then springs down and the plate springs up, causing a sufficient break for up to 600 watts. A larger size is

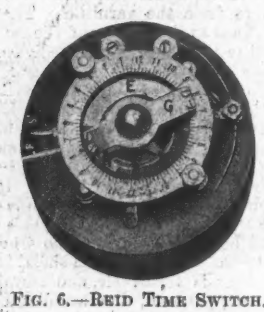


Fig. 6.—Reid Time Switch.

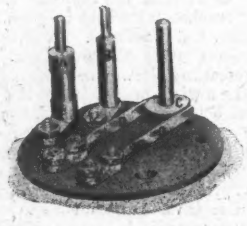


Fig. 7.—Base of Switch.

made for one or two circuits, such as lighting the arc lamps at dawn and, at a later hour, "switching off" and on to an incandescent lamp, and, later still, switching this off; this is in use by the Exeter and other Corporations, and is stated to be perfectly satisfactory.

Fig. 8 is a power-driven time switch intended for powerful currents; it is made in two parts, viz., the clock to which is fixed the switch portion. The switch is driven direct without gearing, and is arranged so that no bridges or bearings are brought to the switch portion, the object being to ensure insulation and to prevent

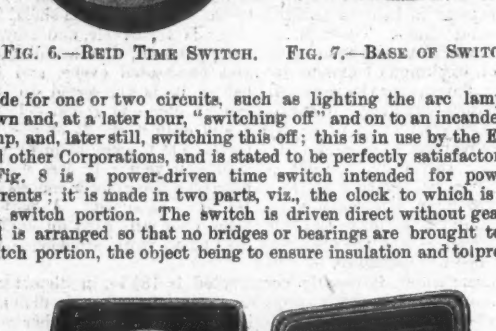


Fig. 8.—Power-driven Time Switch.

the arc when contact is broken, from flashing to any metallic support. The circle around is available for one or many circuits, in fact, the switch can be made to fulfill any purpose which a time switch is intended to serve.

The action is of a most simple character; referring to the illustration, the disk A is tensioned to revolve in the direction of the arrow, and is held in check by the trigger B; as the cam on the clock moves it to the left, the tooth enters its interior until the cam allows it to escape, it then switches "on" or "off" according to the cam, and is caught again by the next tooth.

Coating Iron with Lead.—Hitherto the coating of iron and steel surfaces with lead has been almost exclusively confined to the production of terne plate, as the thickness of lead which can be applied is within narrow limits. The process at present in use consists of dipping the sheets into molten lead, in some cases a small percentage of tin being added. Mr. Cowper-Coles has now developed a new and cheap process, by which the weight of lead deposited can be varied from the fraction of an ounce to any weight up to several pounds per superficial foot. This development opens up a large field of applications, enabling lead coatings to be applied to a variety of purposes—such as the lining of iron pipes inside and outside, or inside only, for the conveyance of corrosive liquors, the lining of pumps, chemical vessels, &c. The process can also be applied to the coating of earthenwae and wood, and to the protection of ornamental ironwork.

Electricians' Wages.—Mr. O'Grady asked the Postmaster-General whether the Corporation of Belfast had since 1904 insisted that contractors carrying out electrical installations should pay the district rate of 8½d. per hour to electricians employed on contracts for the Corporation; and if so, would he insist that the firm of Messrs. Craig & Paton should pay the same rate of wages—viz., 8½d. per hour—to the electricians engaged on the work at the head post office at Belfast?—Mr. H. Samuel said he was not aware of any such arrangements, but he would have inquiry made.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Gas Tar as Fuel.

Engineers who are paying high prices for coal and who are also running short of supplies owing to the strike, will, no doubt, be interested to hear that an easy way of getting over the difficulty is by burning ordinary gas tar.

I have fitted to one of our water-tube boilers the necessary apparatus for burning tar at a total cost of £2, and the same has done its work far beyond expectations. On working out the cost of this fuel, I find it to be little more than the cost of coal at an extremely low rate per ton.

The apparatus is quite a simple one, and I shall be pleased to give details or any information to engineers who are on the verge of curtailing their electric light or power supply.

Wm. C. Bexon,
Engineer and Manager

Kilmarnock Electricity Works,
March 27th, 1912.

Tariffs for Electrical Energy.

On page 524 of your issue of March 29th, I am represented as having said that "the cost of meter-reading ran out at about 9d. or 10d. a day."

What I actually said was, that with men at 30s. per week, reading about 80 meters per day each, and taking 12 readings in the year, the cost of *reading* a meter was 9d. or 10d. *per annum*. As Mr. Lackie had said that the cost of reading the meter and rendering the account was 7s. per annum per consumer, I asked for information as to how the difference was accounted for.

A. J. Cridge.

London, W.C., *March 29th*, 1912.

[We regret the error which arose in the transcription of our notes.—Eds. E.R.]

The Central Station Engineer.

In your issue of last week, "Colonial" has hit upon several evils that exist in the colonial central stations, and I would add that, to some extent, the same evils exist in this country. To my mind a chief engineer of a municipal authority requires an expert knowledge of "human nature," as this would be more useful in saving his bacon than any amount of engineering skill. Once on the back of a tame old horse it is quite easy to guide it. Also the prevalent system of pupilage at central stations is largely responsible for the production of the "self-styled engineer." I would include those young men who, like myself, have ambitions, but no practical means of getting qualified, on account of not having the same opportunities as the moneyed classes.

A. K.

Farnworth, *April 1st*, 1912.

Electric Lighting in the House of Commons.—Replying to Mr. King last week, Mr. W. Benn stated that it was proposed, if found desirable after experimenting, to substitute electric lighting for gas in the debating chamber of the House of Commons. This would probably be more efficient and would certainly reduce the cost of lighting. It was intended to carry out the work in sections in order to give members an opportunity of observing the effect of the change.

Mr. Ormsby Gore asked the hon. member for St. George's-in-the-East, as representing the First Commissioner of Works, whether he would give the House an opportunity of discussing the matter before it was decided to replace the lighting of the House by gas with electric light; whether he was aware of the opinion of leading oculists that gas light was less harmful than electric light; and whether gas assisted in the proper ventilation of the House.—Mr. Wedgwood Benn said an opportunity would arise on the Vote for the House of Parliament. The First Commissioner was not aware that leading oculists had expressed any such opinion in regard to lights placed as those would be. The reply to the third paragraph was in the negative. Under the arrangements proposed the House would be better ventilated than hitherto.

BUSINESS NOTES.

Liquidations.—Reorganisation and Control Syndicate, Ltd., 2, Coleman Street, London, E.C.—Under the compulsory liquidation of this company, which was formed with the object of acquiring the controlling interest in the London Electrobus Co., Ltd., the statutory meetings of the creditors and of the shareholders were held on Tuesday last week, at Bankruptcy Buildings, Carey Street, W.C., Mr. H. M. Winearls, Assistant Official Receiver, presiding. The chairman reported that the statement of affairs lodged on behalf of the company, showed liabilities £2,160, and a surplus in assets with regard to the creditors of £2,840. With reference to the shareholders, however, a deficiency of £5,411 was disclosed. The Official Receiver must, however, point out that there was nothing for the shareholders unless a certain amount of £5,000 was recovered, and, perhaps, nothing for the creditors. The syndicate, which he should refer to as the Control Syndicate, was registered on January 21st, 1909, by Mr. Demetrius John Delyannis, with a nominal capital of £10,000, divided into shares of £1 each, but by extraordinary resolution passed in April, 1910, this was increased to £40,000 by the creation of an additional 30,000 £1 shares, which were to rank *pari passu* with the original shares. The issued capital consisted of 6,424 shares allotted for cash, and £2,000 as fully paid, under an agreement. Some of the cash subscriptions were obtained in response to letters and circulars containing statements which would require investigation. The Official Receiver was, however, unfortunately unable to trace the whereabouts of Delyannis, who, according to the other directors and the secretary, controlled the affairs of the company. In July, 1909, the trustee for the debenture-holders of the Electrobus Co. appointed a receiver and manager of that company's property, and on January 10th following, the Control Syndicate agreed to purchase from the trustee all the undertaking, garage installation, property, and assets of that company for £3,000, payable as to £1,000 in cash and as to £2,000 in shares, to be issued as fully paid. The property, which included 22 'buses, was in the possession of the International Motor Traffic Syndicate, Ltd., which agreed to continue the 'bus service, and to render weekly accounts to the Control Syndicate. In April, 1910, the latter syndicate arranged with one, Dr. Lehwess, for delivery of the property that it had bought; but shortly afterwards the Control Syndicate discovered that eight of the best 'buses and parts had been disposed of by the Traffic Syndicate to another of Delyannis's companies (a Brighton company) for £3,400. The remaining 'buses and parts were sold under a distress levied in July, 1910, for £265. Proceedings were commenced by the Control Syndicate for the recovery of the 'buses, but were unsuccessful on a technical ground as far as the Brighton company was concerned; with regard, however, to the Traffic Co., an inquiry was directed with regard to the amount due under the agreement of January, 1911. At both meetings it was decided to leave the liquidation in the hands of the Official Receiver.

Harris Patent Feed Water Filter, Ltd.—A meeting is called for April 29th, at Sunderland, to hear an account of the winding up from the liquidator (Mr. A. E. Usher).

Wakelin Bros., 9, Tottenham Street, Tottenham Court Road, London.—On March 7th, Mr. W. A. Henderson, of 3, Fenchurch Street, E.C., was appointed liquidator, with a committee of inspection.

Möller Air Filters.—Mr. H. R. Witting, of 41, Berners Street, London, W., who is the sole British representative for the Möller patent air filters, informs us that the following are among the orders for these filters which have been booked during the last six months:—

Rand Mines General, Johannesburg Vereeniging Central Station.—Two filters, capacity 84,750 c. ft. per min.
Glasgow Corporation Tramways.—One of capacity 25,440 c. ft. per min.
Dorman, Long & Co.—Eight of capacity 18,400 c ft. per min.
Edward Lloyd, Ltd.—Two of 12,900 and one of 10,600 c. ft. per min. capacity.
Waihi Grand Junction Gold Mining Co.—One of capacity 10,750 c. ft. per min.
Dick, Kerr & Co.—One of capacity 10,000 c. ft. per min.
Cardiff Washed Coal Co., Ltd.—One of capacity 6,500 c. ft. per min.
Ashington Coal Co., Ltd.—One of capacity 6,000 c. ft. per min.
Vickers, Ltd.—One of capacity 5,000 c. ft. per min.
Coltness Iron Co., Ltd.—One of capacity 3,530 c. ft. per min.
James Howden & Co.—Two of capacity 13,000 c. ft. per min.

Catalogues and Lists.—Mr. O. N. Beck, 11, Queen Victoria Street, London, E.C.—12-page pamphlet (No. 65) containing fully-illustrated and tabular matter, including prices, relating to elastic corrugated tubes for expansion joints, heating and smoke tubes, superheaters, condensers, &c. The corrugations are parallel to each other, instead of spiral, facilitating bending of the tubes to very small radii.

Messrs. Rose Bros., 38 and 39, Beech Street, Barbican, London, E.C.—12-page catalogue showing by excellent illustrations on art paper their portable electric lamps, hand, belt, traveller's, cycle, signal, inspection, watchman's and other types. Lamps with special fittings for aviators are shown, also battery wall lamps, electric clocks and watch-stands, reading lamps, &c. A report on National Physical Laboratory tests of the R. B. Cordesia batteries is printed in the pamphlet.

Messrs. Adnil Electric Co., Ltd., Adnil Building, Artillery Lane, London, E.C.—Leaflet illustrating the slow-speed motor and Marples' patent organ regulator used at Olympia during the run of the "Miracle." A list of institutions to which the firm have recently supplied electric organ-blowing equipments is given.

Messrs. S. Bowley & Son, Wellington Works, Battersea Bridge, London, S.W.—Brochure containing notes on lubrication for power station, railway and other engineers, and drawing attention to the firm's oils for electrical machinery, &c.

The Power Plant Co., Ltd., West Drayton.—Illustrated postal card showing their machine-cut double helical gearing as applied to electrically-driven endless rope haulage machinery for working in collieries and mines.

Messrs. Dargue, Griffiths & Co., Ltd., 138-140, Vauxhall Road, Liverpool.—24-page catalogue giving descriptive particulars regarding their patent "Economic Centralised" system of heating and hot water supply. The system utilises exhaust steam to heat the water, and has been applied in a large number of public buildings and institutions.

Messrs. Marshall, Sons, & Co., Ltd., Gainsborough.—Illustrated circular relating to their oil-burning apparatus for using liquid fuel in all types of boilers. The circular emphasises the importance of the use of liquid fuel in view of the coal strike. The firm make a special feature of converting boilers for oil burning.

Messrs. Mather & Platt, Ltd., Salford Ironworks, Manchester.—Thirty-two page catalogue, containing full descriptive particulars of their patent mechanical filters for industrial purposes. Excellent half-tone pictures and clear line drawings are given of these filters supplied for various installations. A number of pages are occupied with a list of buildings, mills, factories, breweries, &c., where such installations are at work.

Trade Announcement.—The Accessories Manufacturing Co., Ltd., announce that, by arrangement with Messrs. Samuel Heath & Son, Ltd., Birmingham, who have acquired the business of the Electrical Fittings Co., Ltd., 38, Conduit Street, W., they are carrying on this business at 11, Dean Street, Oxford Street, London, W., on their behalf. A fittings showroom will shortly be opened at that address, and a new catalogue is in course of preparation.

Book Notices.—"Provisional Regulations for Examinations in Art and in Science and Technology, applicable to the Examinations of 1912." London: Wyman & Sons, Ltd. Price 2d.

"Lehrbuch der Photometrie." By Friedrich Uppenborn and Berthold Monasch. 1912. Munich: R. Oldenbourg.

"*Bulletin* of the Bureau of Standards." Vol. VIII, No. 1. January, 1912. Washington: Government Printing Office.

"Atti della Associazione Elettrotecnica Italiana." March, 1912. Milan: Stucchi, Ceretti e Cie.

For Sale.—Messrs. Fuller, Horsey, Sons & Cassell will, on April 18th, sell by auction, at Vine Street, E.C., the goodwill, electrical plant, machinery and stock, of Messrs. F. A. Glover and Co., Ltd. See our advertisement pages in this issue.

LIGHTING and POWER NOTES.

Accrington.—The Electricity Committee has considered the supply of current for power purposes to cotton manufacturers and other large power users during ordinary factory hours, and has resolved to fix a charge of 5d. per unit on a minimum consumption of 250,000 units per annum, at a coal price basis of 12s. per ton, and subject to the usual sliding scale variations of 0·025d. for every 10 per cent. fluctuation in the price of steam coal delivered.

Ashton-under-Lyne.—The B. of G. has decided to have the electric light installed at the workhouse.

Balderton.—The village is about to undertake an electric lighting scheme, having been unable to come to terms with the gas company. A parish meeting was held, when Mr. Dilley explained a scheme by which electricity could be obtained from the works of Messrs. J. Simpson & Co., Ltd., engineers. The cost was estimated at £600, as follows:—Main cables for 1,300 yards, £54; distributing cables, £92; 75 copper lamp shades, £32; 75 standard brackets, £22; brackets and cables, £13; 75 steel standards, £186; 75 wooden supports, £56; switchbox, £10; labour, £50; legal and other expenses, £33; extras, £50. The running cost would be 75 lamps for 1,500 hours at 1d. per unit, £33; labour for switching and cleaning, £12 10s.; repairs and renewals, £9; repayment of capital and interest, £17; making a total for the first year of £115. This would be a diminishing sum year by year. A rate of 2¼d. in the £ would provide £117. Messrs. Simpson were willing to guarantee a supply of electricity for street lighting for 15 years (the parishioners to have the option to terminate the agreement at the expiration of five or ten years) at a cost of 1d. per unit, which amounted to about £32 or £35 a year. A formal resolution was passed to raise a loan of £650 for the purpose.

Birmingham.—The City Council has authorised the Electric Supply Committee to erect a new boiler house at Summer Lane station and provide new boilers, &c., at an estimated cost of £28,900, in lieu of the extension previously authorised at £14,250, and resolved that the application to the L.G.B. be amended accordingly, and that the Finance Committee be instructed to borrow the amount required. The Council has also given its approval to the proposed loan of £10,000 to inaugurate a scheme of wiring houses upon the hire system.

Bispham.—The electric light was used here for the first time on March 27th and proved extremely satisfactory. It is stated that there are reserves of coal, so that the lighting of the township is assured for some time to come.

Bolton.—The British Westinghouse Electric and Manufacturing Co. has kindly undertaken to supply, on special terms, motors to drive the machinery which is being installed at the Technical School by Messrs. Dobson & Barlow, Ltd.

Bradford.—The Corporation Electricity Committee proposes to extend electricity mains in various parts of the city at an estimated cost, including provision of transformers and switchgear, of £5,255, this figure including the tender of the Paterson Engineering Co. for the supply and erection at the Valley Road Electricity Works of oil-eliminating plant for feed water purification for £605, and the tender of the Sandycroft Foundry Co. for the supply and erection at the Valley Road Works of one emergencey excitation battery and stands for £488 10s.

Bridlington.—The T.C. has decided to apply to the L.G.B. for a loan of £1,500 for the extension of the condenser plant at the electricity works.

Canada.—A movement is on foot to have the Niagara Falls illuminated by electricity during the evening hours. Senator Gittins, of Niagara Falls, New York, has presented a Bill at Washington for $50,000 to pay the United States share of the expense. It is proposed to spend $100,000 on a permanent means of illumination, and allow $5,000 per year for the upkeep of the same. It is to be an international affair.

The Ontario Hydro-Electric Commission has taken steps to expropriate the Chats Falls water power as a source of available power for Eastern Ontario. These falls are owned by the Hon. William Harty, of Kingston, who is said to have secured this 150,000-H.P. from the late Laurier Government for $60,000.

Cheltenham.—On March 26th a B. of T. inquiry was opened into the application of the T.C. for an order to extend the area of supply to 10 parishes in the areas of the Cheltenham and Winchcombe R.D.C.'s; as intimated in a recent issue of the ELECTRICAL REVIEW, there was opposition on behalf of the Cheltenham R.D.C. and the Gas Co., and by private persons. Owing to the statutory notice not having been given, the parishes of Badgeworth, Up Hatherley, and Shurdington were withdrawn from the scheme, and the T.C. offered, in the event of the order being granted, to give the Cheltenham R.D.C. a reasonable purchase clause, modifying the term of 42 years laid down in the Act.

Chesterfield.—A L.G.B. inquiry was held on March 26th into the application of the T.C. for a loan of £7,000 for extensions at the electricity works and additional plant. The Inspector, Mr. H. R. Hooper, thought the application was not large enough, and the matter was adjourned temporarily for consideration by the Electricity Committee.

Chile.—The *Diario* of February 21st publishes a decree approving the plans submitted by Don Antonio Bellet for the erection of a central generating station designed to supply the town of San Javier with electric light. Twelve months are allowed for carrying out the work.

Continental Notes.—GERMANY.—Under the auspices of the Allgemeine Electricitäts Gesellschaft, of Berlin, a company has lately been formed at Gotha with a capital of £300,000, and the title Die Thuringer Electricitäts Lieferungs Gesellschaft, to exploit a concession granted by the Duchy of Saxe-Coburg-Gotha to the A.E.G. for the supply of electrical energy for lighting and power purposes, and for the construction and working of electric tramways throughout the Gotha district, which extends from Gotha to Ersenach in one direction, and to the south as far as Meiningen. The generating station in Gotha of the Gotha Electricitatswerk und Shassenbahn Gesellschaft is being taken over and extended, and, in addition, a new generating station, having a capacity of 12,000 H.P., is to be erected at Altenbrietungen. The two plants will be interconnected by an overhead transmission line working at a pressure of 25,000 volts, so that they will form a mutual reserve for each other. The new undertaking is taking over the tramways in the town of Gotha, and a new electric railway is to be built between Gotha, Friedrichroda and Grosslabarz, with a branch to Waltershausen.

SPAIN.—In the Spanish Province of Cataluna are very considerable water powers under development, whose energy for the greater part will be transmitted to Barcelona. The following companies are at the present time busied with the erection of new stations:—(1) La Energia Electrica de Cataluna.—This is a foundation of the Compagnie d' Electricité de Paris, and utilises the falls of the Lac de Capdella, to the north of Barcelona, in the Province of Lerida. The station will supply about 40,000 H.P. at a pressure of 80,000 volts to Barcelona. (2) The Compania de Fuerzas Motrices y Riegos del Ebro.—This company was founded by Canadian capitalists, at the head of whom is Dr. Pearson. The falls of the River Ebro will be utilised to the extent of about 100,000 H.P., the current being distributed in the Provinces of Barcelona, Gerona, and Tarragona. This company has bought up the station of the Compania Barcelonesa de Electricidad, which has a capacity of 40,000 H.P. at its steam plant. (3) The Fuerzas Motrices de Cataluna.—This undertaking was formed of the Compania Cataluna de Gas y Electricidad and the firm Bertrand y Ca. The company utilises the Esera Falls in the north of the province of Huesca, and will place about 30,000 H.P. at the disposal of Barcelona. For the support of its hydraulic stations the Energes de Cataluna will, besides, build a steam station in Badalona, the equipment of which will consist of two steam turbines and generators of 8,000 KW. capacity each. The province of Cataluna, with its capital Barcelona, contains the greatest industrial undertakings in Spain. The entire Spanish textile industry is there located. The machine-worked factories of Barcelona, with the localities Sabadell, Tarrasa, Manresa, Badalona, Mataro, Montgat, Cranotlers, &c., now employ steam power aggregating 180,000 H.P. If it is further borne in mind that Barcelona itself is a great town with considerable consumption of light, it will be seen that these schemes are justified, and that these remarkably large additional supplies of electric current are likely to find ample and profitable appropriation.—*Elekt. Zeitschrift.*

Croydon.—The T.C. has decided to terminate on September 29th the lease of the electricity showroom premises at 3, Park Lane.

Darwen.—Sanctions have been received from the L.G.B. for the borrowing of the following sums: £2,025 for high-tension mains; £1,393 for low-tension mains and small branch mains (£200); £850 for services and £400 for meters. It was resolved that the sum of £20, excess expenditure on capital, be taken out of revenue.

The T.C. has referred a recommendation in favour of the purchase of a new turbine to a sub-Committee for report to the General Purposes Committee.

Eccles.—The electrical engineer has been instructed to prepare an estimate of the cost of extending the boiler house, so as to accommodate an additional boiler. The Public Lighting Committee has decided to make application to the L.G.B. for sanction to borrow £5,220 for the purposes of the electricity undertaking, which sum includes £2,000 for mains, £750 for services, and £750 for transformers.

Egypt.—According to *Elektrotechnik und Maschinenbau*, an official of the Finance Department of the Khediveh has undertaken a journey to Europe to raise a loan on the private possessions of the Khediveh, with the object of purchasing dynamos and other electrical material, engines and boilers, &c., for certain improvement works which are projected.

Ellesmere Port.—At its monthly meeting the Council unanimously adopted without discussion the recommendation of the newly-formed Electricity Committee, that the Council which lately passed a resolution to apply for a provisional order, agrees to the application for such an order being made by the Mersey Power Co., Ltd., instead of by itself. The Widnes Corporation obtained an order, but transferred it to the Company, and the charges the Company may make are governed by the agreement between the Corporation and the Salt Union, Ltd. This agreement has been taken as the basis of the arrangement with Ellesmere Port. The traction clauses are struck out as inapplicable to the Port (though the question of electric car services with Birkenhead and Chester have been repeatedly discussed) and some of the other clauses are modified. For public lighting the charge for current is not to exceed 2d. per unit; and for private lighting 4½d., during the first seven years and 4d. thereafter. For power the charge is limited to 1½d. with a minimum, or £6 per K.W. of the subscriber's maximum demand with $\frac{3}{10}$d. per unit, and consumers are to be allowed to use on the same premises current supplied primarily for power, for either heating or lighting, or both, at power rates. There are provisions for reducing the charges after 21 years.

Epsom.—Subject to the consent of the L.G.B., the U.D.C. had decided to install at the electricity works a Diesel oil engine at a cost of £3,721.

Goole.—The R.D.C. on March 28th consented to the proposals of the Electrical Distributon of Yorkshire, Ltd., which is applying for a provisional order under the Electric Lighting Acts to supply electricity to some of the villages in the district.

Ilkeston.—The Council's engineer is to prepare specifications, &c., for the lighting installation at the new secondary schools; he has also been given charge of all the electrical and mechanical work in the various Corporation departments, including the new sewage pumping and disposal works.

India.—The Delhi Electric Tramways and Lighting Co. has applied to the Punjab Government for permission to amend the provisions of its licence, so as to include within its area of electric supply the whole of the area which may be contained within the limits of the Imperial City of Delhi.—*Indian Engineering.*

Leyton.—The estimated surplus for the year ending March 31st, 1912, on the electricity undertaking, is put at £1,934. Half of this sum is to be carried to the reserve fund for depreciation and renewals, and the balance is to be given in aid of the rates. For the ensuing year the surplus is estimated to amount to £1,005. The electrical engineer has been directed to obtain quotations for two miles of 2 sq. in. cable required for giving a supply to the L.G.O. motor garage and the Stratford Co-operative Society.

London.—LAMBETH.—The Baths Committee of the Council reports having had under consideration the question of improving the exterior lighting of the baths, which are at present illuminated by five 1,000-C.P. arc lamps and 12 35-C.P. metallic-filament lamps. Quotations have been considered from the South London Electric Supply Corporation and the Gas Light and Coke Co. for lighting by means of electricity and high-pressure gas. The offer of the Electric Light Co. is to supply, fix and maintain and keep in lighting eight 2,500-C.P. flame arc lamps from an hour after sunset to midnight, six days a week, for £11 per lamp per annum, subject to an agreement being entered into for a period of five years. The Gas Co. submitted three quotations for 10 high-

pressure gas lamps from ordinary lighting-up time to midnight for six days a week, subject to an agreement for three years, viz., 3,000 C.P., £16 10s. per lamp per annum; 2,000 C.P., £14 per lamp; and £1,000 C.P., £8 15s. The Committee, being of opinion that the offer of the Electric Light Co. was the more favourable of the two, has accepted its offer on the terms mentioned.

Poplar.—It is stated that the L.C.C. has agreed to sanction borrowing powers of £69,626 applied for by the B.C. for electricity extensions.

Lytham.—On the agenda for the General Purposes Committee, on March 28th, was the subject "Electric Light"; Councillor W. F. Holden, J.P., was the prime mover in the matter. The meeting decided to give consideration to the question of providing an electrical supply and to make the necessary inquiries. Years ago the authority obtained a provisional order from the B. of T., and at one time it seemed likely that it would proceed to act under that order, but the scheme was eventually abandoned and the order passed into the hands of a private company. A very recent effort by this company to raise the necessary capital was unsuccessful.

Manchester.—The Corporation Electricity Committee has decided that the supplies of electric current to some of the largest power consumers will be cut off for five days, beginning on Good Friday, on account of a shortage of fuel through the coal strike. Circulars to this effect have been sent out. Manchester Corporation supplies electric current to Failsworth, Denton, Droylsden, Heaton Norris, and Audenshaw, and altogether about 40 firms will be closed down as a result of the decision.

Norwich.—A L.G.B. inquiry was held on March 26th into the application of the T.C. for a loan of £25,000 for electricity purposes, made up as follows: Turbo-generator, £10,000; mains, £6,000; services, £3,000; new offices, £3,000; and two boilers, £3,000. There was no opposition.

Sevenoaks.—The U.D.C. has received from Messrs. Crompton & Co. proposals regarding an electric light scheme for the town. The firm offers to form a company to take over the Council's powers under an order, to proceed at once with a scheme, and to pay up to £400 towards the cost of obtaining the order. The Council has decided to favourably consider the application of Messrs. Crompton, and to ask the B. of T. for its advice on the matter, and permission to accept the offer, subject to an undertaking on the part of the firm to put down the installation within a given time.

South Africa.—The Wynberg Municipal Council has accepted the tender of the Kalk Bay Municipality for the supply of electricity, the Wynberg Council, it is stated, furnishing capital to the amount of between £15,000 and £20,000.—*South Africa.*

Southampton.—The estimates of the electricity undertaking for the year 1912-13 provide for an income of £49,200, as against £45,070 for 1911-12. The expenditure is put at £26,429, as against £24,276 for the previous year. Provision is also made for a contribution of £6,660 in aid of the district rate. In connection with these estimates the electrical engineer points out that the results of the Council's hiring-out scheme have been most satisfactory, and would have an accumulative effect as to receipts. The charge for current for power to the Tramways Department is to be reduced to 1½d. per unit.

Stalybridge.—The Stalybridge Joint Board on Thursday, last week, decided to give notice to large consumers of electricity of the Board's intention to cease the supply of electricity. Several mills and workhops in the town are dependent upon the Tramway Board for electricity for motive power.

Warrington.—The Electricity Committee has adopted a recommendation of a Sub-Committee for a restricted-hour supply for power and heating purposes, to consumers who agree not to use current between the hours of 3.30 p.m. and 5.30 p.m. during the months of November, December, January and February, at a charge of £2 per KW. per annum of sustained maximum demand plus ½d. of a penny per unit. A special time switch will be used in connection with this supply, the approximate rental being 10s. per annum. Consumers under the above rate will be required to agree to take current for a period of not less than 12 months. This rate will not apply to installations of under 20 H.P.

York.—The Electricity and Tramways Committee of the T.C. has recommended the application to the L.G.B. for a loan of £4,955, for two new water-tube boilers with chain-grate stokers and an economiser.

TRAMWAY and RAILWAY NOTES.

Argentina.—The *Boletin* of February 22nd contains a law empowering Sres. Lacroze Hermanos y Cia to construct and work a double-track underground electric railway from Federico Lacroze station (Buenos Ayres Central Railway) by way of the Calle Corrientes to the Paseo de Julio, Buenos Ayres.

Asiatic Turkey.—Smyrna is served by two horse tramways, operated by French and Belgian owners respectively. The lease to the latter being almost at an end, it has been decided to renew it for another 50 years on condition that the line is electrified, and that 30 per cent. of the net profits are paid over to the municipality. It is understood that the French company's concession will be similarly treated when the opportunity serves.

Blackpool.—It having been legally decided that tramways are to be assessed for district rate purposes on the same footing as railways—at one-fourth—the Tottenham authorities, against whom the decision was pronounced, are now appealing to other authorities to assist them to take the matter to the House of Lords. The application came before Blackpool Finance Committee on March 28th, and it decided to assist in the appeal. The question is of extreme importance to Blackpool authorities, seeing that two companies run cars into the town

Bradford.—The Corporation Tramways Committee has decided to recommend the building of 12 new electric cars, complete with equipments, at an estimated cost of £8,400, and that 12 additional new car equipments be purchased at an estimated cost of £3,600.

Canada.—A group of English capitalists has held a conference with R. H. M'Ellroy, M.P. for Carlton County, Ont., with a view of taking over the stock of the proposed Kingston, Smith's Falls and Ottawa Electric Railway Co.

The electric railway systems throughout the Dominion, in common with other industrial enterprises, have received a large share of the general prosperity of the past year. The net profits of seven of the more prominent roads amounted to $10,500,000. Montreal, with 154 miles of track, had total earnings of $4,775,300. Toronto, with 110 miles of track, earned $4,851,541, and Winnipeg, with a mileage of 70, earned $3,829,749.

The Halifax Tramway will expend $200,000 this year in improving and extending its tracks. A new auxiliary steam plant of 12,000 H.P. was constructed during the year. The company now has auxiliary power to the extent of 20,000 H.P. available in the event of a serious breakdown at the hydraulic plant.

Continental Notes.—Germany.—An unlooked for accident occurred on the Berlin underground railways last week. In connection with extensions on the other side of the River Spree, work was in progress for building a concrete tunnel under the river, a portion of the latter being fenced off by means of a coffer dam for the purpose, so that work could be carried on in the open excavation. It is suggested that the dam gave way and the inrush of water found its way into the working railways under Berlin, the latter being, in consequence, closed down, pending the blocking up of the tunnel leading to the river and subsequent pumping out of the water.

It was recently intimated in the Budget Commission of the Prussian Diet that a scheme would shortly be presented in relation to the proposed conversion to electric traction of the Berlin City, Circle, and Suburban Railways, and since then the Minister for Railways has submitted a memorandum on the subject to the Lower House. After referring to the development of the passenger traffic during the past 20 years, the report states that the carrying capacity of the railways is already inferior to the requirements of the traffic, and notwithstanding the increase in the number of trains and accommodation, the carriages are at times intolerably crowded on almost all the lines. At present with heavy tender locomotives it is possible to operate a maximum of 24 steam trains hourly in each direction over the city lines, giving seating places to a total of 11,712 persons. In 1916 it will be necessary to increase the number of trains to 30 per hour, in order to satisfactorily deal with the constant growth of traffic, whilst later on the expansion will render it essential to have 40 trains per hour in each direction, providing sitting accommodation for 24,400 persons.

The memorandum proceeds to state that, in order to cope with the augmentation in traffic, the most suitable form of working for the Berlin railways is by means of electric traction with locomotives, and the process of conversion would require a period of 4½ years from the time of the voting of the necessary funds. According to the scheme which has been prepared, the trains on the City and Circle lines are to consist of 13 three-axle passenger coaches in times of the heaviest traffic, whilst those on the suburban lines are to be composed of 12 coaches and a luggage van. An electric locomotive is to be provided at each end of the train and will receive current from an overhead conductor at 15,000 volts and 16⅔ periods. During the hours when the passenger traffic is light, the trains will be divided and only one locomotive will be used. It is intended to retain the motor-car trains which have been in service for a number of years on the Berlin section between the Potsdamer railway station and Gross Lichterfeld-Ost and which are operated on the direct-current system. A conversion of this line to the alternating-current system, it is submitted, would not be advantageous as the existing costly electrical equipment would become worthless. Nevertheless, the direct current is to be produced from an alternating-current converter installation, and this will result in the realisation of considerable economy as compared with the existing state of affairs.

It is proposed to obtain the electric power for working the railways from two power stations, and a legally binding offer for this purpose has been made which ensures the supply on advantageous terms for a period of 30 years certain. According to the offer, one power station would be erected in a lignite coal district, presumably near Bitterfeld, and the second would be established near Berlin, partly as a reserve station and partly to assist in

meeting the load in excess of the average consumption, that is to say, when the density of traffic is the greatest. The feeder mains are to be underground cables for a pressure of 60,000 volts, and the transmission from the power stations to Berlin is to be effected by six pairs of cables, which are to be so arranged that injuries cannot disable more than one pair of cables at the same time. The power will be transmitted by the long-distance cables to a number of transformer sub-stations, where the pressure will be reduced to that required for the working conductor—15,000 volts. It is estimated that an expenditure of £4,500,000 will be incurred by the contractor for the supply of energy in establishing and equipping the two stations, each of which will have a capacity of 100,000 KW., and in providing the feeders and sub-stations.

The expenditure contemplated by the Railway Ministry amounts to £6,167.000, of which £2,500,000 will be for the installation of the working conductor, alterations of platforms, and of certain tracks, workshops, the provision of wiring, &c.; whilst the balance is required for the acquisition of, and alterations to, rolling stock. It is proposed to provide 557 electric locomotives, 690 passenger coaches, and 29 service vehicles, and 573 steam locomotives will be released for use elsewhere. At present the receipts of the City and Circle Railways do not cover the working expenses, and a deficit of £99,000 is estimated for 1912. As a consequence, no interest is earned on the invested capital. It is, however, intimated that on the conversion of the railways to electric traction, it will be necessary to raise the passenger fares not only in order to extinguish the deficit, but also for the purpose of providing for depreciation and, at the same time, obtaining interest on the new capital expenditure.

Among new German electric railway schemes are the following:—The construction of electric lines is projected, running from Lüchow, in Hannover, to Bevenzen and Uelzen respectively; a line from Mannheim to Waldhof and Sandhofen is to be constructed by the Oberrheinischen Eisenbahngesellschaft; the plans have been prepared for a line from Opladen to Burscheid, in the Rhine province; the T.C. of Delmenhorst, in the Duchy of Oldenburg, has started the preliminaries for a line from that town to Lemwerder; and the T.C. of Stuttgart is considering a project to establish electric transit facilities between that city and Kannstadt.

The efforts of the Government of Baden on behalf of the electrification of various subsidiary lines are daily taking more tangible shape. The first line to be taken in hand will be that of the Wiesen Valley. The great power station at Augst-Wyhlen, which has been built by the City of Basle and the Rheinfelden power company jointly, is capable of supplying at normal water-level 30,000 H.P., while at the same time good and cheap water transit is secured between Basle and Rheinfelden. Regular navigation for vessels will be available by the middle of the summer.—*Elek. u Masch.*

Budapest.—The T.C. has drawn up regulations relating to the construction and equipment of such electric motor-cabs as may be licensed for use in the capital. It is required that the electric vehicles shall carry four passengers and their luggage throughout the city, the accumulators being equal to covering a distance of 80 km. The vehicles are to be after the laundaulet model, fitted with side window, forward roof, space for luggage on the top of the roof, with brass mounting fittings at back, a hook for the reserve wheel, two electric or petroleum head lamps, and two reserve acetylene lamps, with reservoir, for extra-urban travel, and a glass blind in front of the driver. The body of the vehicle is to be painted blue, and its number at the rear lit up, an electric lamp being fitted to light the interior.—*Elek. u. Masch.*

Russia.—Permission has been accorded to the railway contractor, N. N. Kaschinew, for the building of two electric long-distance lines from Moscow to Podolsk and Obiralowka respectively. The total extent of the two lines is 55 versts. The Government has refused to give a guarantee.—*Zeit. Elek. und Masch.*

Hull.—It was reported to the Corporation Tramways Committee on March 27th that successful experiments had been made at the power station with oil fuel. Two boilers had been fitted with the installation, and the steam was generated entirely by the oil fuel. The city engineer, Mr. White, said the cost was much cheaper than coal at the present prices, but it would be more expensive than coal at the normal contract prices, and the experiment would not be continued after coal prices were normal again.

Ilkeston.—Last week we noted the stoppage of the Corporation tramways. We are informed by Mr. Stokes, the engineer and tramway manager, that this is owing to the failure of the Derbyshire and Notts. Power Co. to continue its bulk supply contract. The company's station is situated at a pit, and the shortage of fuel is causing some surprise.

Leyton.—The Tramways Committee reports that the estimated surplus for the year ending March 31st, 1912, will amount to £2,846. Of this sum one-half is to be carried to the reserve fund for depreciation and renewal and the other half is to be given in aid of the rates.

London.—The G.C. Railway Co. has been experimenting with a petrol-electric coach accommodating 50 passengers, on its Marylebone-South Harrow route. Speeds of 40 or 50 miles per hour are obtainable, and the car has a working range of 150 miles. A somewhat similar, but smaller, coach is in use by the G.W. Railway Co. on its Windsor-Slough branch.

The Highways Committee of the L.C.C. is proposing to send a deputation to the Home Secretary to urge the necessity for more sympathetic co-operation by the Metropolitan Police authorities in connection with the Council's tramways.

Mexico.—According to a recent issue of the *Financier*, the Mexico tramway system was recently held up for about an hour, owing to bandits tampering with the Necaxa transmission lines. The damage was repaired in this case, but the company has four local power plants available in case of serious trouble.

Oldham.—It was reported to the Oldham Tramway Committee on Thursday evening that during the year ended March 25th a record had been created in tramway receipts, which exceeded £100,000, for the first time. The total receipts were £100,364. There had been 20,072,908 passengers against 19,125,202 in the previous year. The cars had run 1,940,740 miles, against 1,892,785, yet there had been a saving in energy to the value of £1,128.

West Bromwich.—With regard to our note under this heading last week, we regret that we were misinformed as to the use of railless trolley vehicles in the town, no such scheme being under consideration.

TELEGRAPH and TELEPHONE NOTES.

Automatic Telephone Equipment.—The Postmaster-General last week said that the small exchanges being installed at Epsom and at the General Post Office, London, are expected to be completed in April and May, respectively. Larger exchanges are contemplated for Leeds, Brighton, and Portsmouth, but their provision must depend to a considerable extent on the possibility of obtaining the switching equipment at near dates from manufacturers in this country.

Colonial Wireless Telegraph Stations.—In reply to a question in Parliament recently, Mr. Harcourt stated that the wireless stations in Jamaica, Trinidad, and British Guiana had been erected and were being maintained at the cost of the cable companies, and another station in Trinidad at the cost of the Colonial Government. The power at these stations varied from 1½ to 3 KW. In British Honduras negotiations were proceeding on the basis that the Government should erect a 3-KW. station, and that a private company should refund the initial cost and the loss on its operation. In the Bahamas only a local private system between Nassau and Abaco had, so far, been authorised, each station to have a power of 1½ KW. The Barbados Government was considering the question of erecting a Government station, but the power and system to be adopted were not yet decided.

Mr. Harcourt, in reply to another question, said that in Jamaica the Lepel system of wireless telegraphy was in use, and in Trinidad, British Guiana and Tobago the Lodge-Muirhead. In the cases of British Honduras, the Bahamas and Barbados, neither the system which would be adopted, nor the estimated cost, could yet be stated, with the exception that the cost of erection and equipment of a 3-KW. station in British Honduras had been roughly estimated at £2,000 to £2,500. The cost of maintaining the two wireless stations of the Trinidad-Tobago service was about £900 a year. The cost of maintaining the stations of the Trinidad-British Guiana service and the Jamaica station could not be given, since these stations were in the hands of private companies.

London Telephone Service.—The Telephone Committee has decided to raise a debate on the administration of the telephone service on Wednesday, April 10th.

Nauen Station Wrecked.—On March 30th the wireless station at Nauen, near Berlin, was blown down in the gale. No one was hurt. The tower, as recently mentioned, had been doubled in height, and was 660 ft. high. The tower was supported on a single ball and socket base, and there was a similar joint between the lower and upper halves. The rebuilding will take five or six months, and cost £25,000.

Pacific Cable.—The total number of words sent over the Pacific cable system, exclusive of inter-colonial traffic between Australia, New Zealand, and the Fijis, amounted to about 208,000 words in January, 1912, and about 211,000 in February, 1912, as follows:—

	Jan., 1912.	Feb., 1912.
Ordinary	123,731	124,847
Deferred ordinary	13,902	14,351
Government	15,212	15,230
Press	41,830	28,095
Deferred press	13,907	28,913
	208,582	211,436

The Telephone Transfer.—The Postmaster-General's attention was recently called to the fact that, notwithstanding his agreement with the National Telephone Co. to pay interest on the unpaid purchase money for the company's property taken over by him, certain preference capital of the company, amounting to nearly 3½ millions sterling, was being deprived of any interest pending the payment of the purchase money by him, owing to the form of the company's articles of association. He replied that the agreement to pay interest on the unpaid purchase money would be carried out, and a further instalment of the purchase money could be paid by means of annuities or Exchequer bonds if an award on account could be obtained from the Railway and Canal Commissioners; but he was unable to say how the company's articles of association would affect the distribution of such instalment by the liquidator.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Victoria.—April 23rd. 2,000-kw. steam turbo-alternator, for the Melbourne City Council. See "Official Notices" March 1st.

April 24th.—Power generating plant for the Federal Capital site. Secretary, Department of Home Affairs, Russell Street, Melbourne.

May 1st and 8th.—Cable for P.M.G.'s Department.

May 14th.—Telephones, switches, condensers and protectors, for Melbourne. See "Official Notices" March 22nd.

May 15th.—As stated last week the Electric Supply Committee of the City Council of Melbourne are inviting tenders for an electrical three-seated motor-car fitted with Edison storage battery capable of running 80 miles on one charge at an average speed of 20 miles per hour fully loaded, and two electric motor vans for loads of 1,000 and 2,000 lb. respectively, at an average speed of 15 miles per hour. Tender forms and specifications can be obtained from Messrs. McIlwraith, McEacharn & Co. Propy., Ltd., Billiter Square Buildings, London, E.C.

May 21st.—P.M.G., Melbourne. 30 miles of cable, 24¼ miles of cable, 699 non-polarised relays. See "Official Notices" to-day.

July 23rd.—P.M.G., Melbourne. Nine sections of a lamp-signalling trunk-line switchboard. See "Official Notices" to-day.

Queensland.—April 24th and May 8th. Telegraph and telephone material, for the P.M.G.'s Department. See "Official Notices" March 15th.

May 8th.—Telegraph and telephone instruments, switchboards and accessories, measuring instruments and protectors, for the P.M.G.'s Department. See "Official Notices" March 22nd.

South Australia.—April 24th. Telephone and telegraph material, for the P.M.G.'s Department. See "Official Notices" March 15th.

Western Australia.—May 8th. Common-battery telephones, for the P.M.G.'s Department. See "Official Notices" March 22nd.

Tasmania.—June 10th. Telegraph and telephone material, for the P.M.G.'s Department. See "Official Notices" to-day.

Belfast.—April 8th. Two 750-kw. turbo-alternators, condensing plant, and E.H.T. switchgear, for the Corporation. See "Official Notices" March 8th.

Brazil.—Pernambuco.—April 18th. Concession for the establishment and working of several lines of electric tramways. Preliminary deposit, 20,000 milreis; final deposit, 80,000 milreis. Particulars, Direction Générale des Travaux Publics, Pernambuco.

Cape Town.—May 15th. Two electric passenger lifts for new Law Courts. Specifications, &c., from District Engineer, Public Works Dept. Deposit £2.—*Board of Trade Journal.*

Dublin.—April 15th. Flame arc lamps and suspension gear, for the Corporation. See "Official Notices" March 29th.

France.—Rouen.—Six 4,000-kg. capacity and four 2,500-kg. capacity electric cranes, with automatic driving machinery, for the harbour. Particulars, Président de la Chambre de Commerce, Rouen.

Germany.—April 15th. The municipal authorities of Frankfort-am-Main are inviting tenders for the supply of four 5-ton electrically-operated cranes.

Pilsen.—April 15th. Sundry machine tools with electric driving. Particulars from the K.K. Staatsbahndirektion, Pilsen.

Krakau.—April 15th. For the railway workshops at Neu Sandez. One electric drilling machine for 20-mm. holes, one electric exhauster, one portable electric boring machine for 50-mm. holes, one electric circular saw (for wood), two turning lathes of 200/1,000 mm. and 150/750 mm. respectively, one pneumatic riveting hammer, one 1-H.P. continuous-current motor, and one 2½-H.P. three-phase-current motor, &c. Deposit, 5 per cent. of cost. Particulars, K.K. Staatsbahndirektion, Krakau.

Leeds.—April 20th. Eight miles of ·2 sq. in. three-core cable, 6,600 volts, for the City Council. See "Official Notices" to-day.

London.—L.C.C.—April 16th. Supply, during twelve months, of 484 tons of rolled-steel bar, special section, for magnetic brakes of electric cars. Chief Officer of Tramways, 62, Finsbury Pavement, E.C.

The Highways Committee is about to invite tenders from selected firms for the renewal of the electrical installation in Blackwall Tunnel (£4,000, estimated). The matter will be fully settled during the Easter recess.

April 16th.—Electrical installation at the Lyham Road School. See "Official Notices" March 29th.

Metropolitan Asylums Board.—April 10th. Two electrically controlled passenger lifts at Tooting Bec Asylum. See "Official Notices" March 22nd.

Metropolitan Water Board.—April 12th. The Board is inviting tenders for 6 Diesel oil engines and two 10-ton overhead cranes for Cricklewood and Fortis Green pumping stations, also one Diesel engine and one 8-ton overhead crane for Green Street Green pumping station. Specifications and forms of tender from the Chief Engineer's Department, Savoy Court, Strand, W.C.

St. Pancras.—April 15th. Lead-covered armoured cables, for the B.C. See "Official Notices" March 22nd.

H.M. Office of Works.—April 17th. Conduit boxes for two years. See "Official Notices" March 29th.

New Zealand.—May 1st and July 1st. Public Works Department. Supply to Lyttleton, under the Lake Coleridge electric power scheme, of pipe lines, valves, water-wheels, generators, switchboards, transformers, and accessories, also travelling crane. The sections to be tendered for by July 1st are:—Lightning arresters, insulators, bare conductors, insulated cables, pole switches, testing transformers, supply meters, batteries and accessories. Particulars can be seen at Board of Trade Com. Int. Dept. in London. Tenders for the whole, or for any section, should be addressed to the Minister of Public Works, Wellington.

Rhodesia.—Salisbury.—April 15th. (1) Cables, poles, and line material; (2) power station equipment for lighting. London agents: Davis & Soper, 54, St. Mary Axe, E.C. Deposit £5. Must be British or British-Colonial manufacture.

Russia.—Mosdok.—The T.C. invite offers for a concession to supply electric lighting.

Spain.—Tenders have just been invited for the concession for the working during a period of 15 years, of the telephone exchange in the town of Pamplona (province of Navarra).

The municipal authorities of La Escala (province of Gerona) have just invited tenders for the concession for the electric lighting of the town.

Turkey.—Constantinople.—June 15th. Tenders are invited for a concession to lay an electric suburban tramway system to serve Skutari, Kadikoi and neighbouring districts. Particulars from the Ministry of Public Works.

Vienna.—April 15th. The Imperial and Royal State Railways Direction invite tenders for some 50 machine tools of various kinds, with electric driving equipment (including boring, shaping, riveting and leather-sewing machines, metal and wood circular saws, electric fans, portable electric dust-exhausters, eight cranes, &c.). Particulars, K.K. Direktion der Staatseisenbahnen, Schwartzenbergplatz 3, Vienna I.

Walsall.—April 22nd. Seven tramcar bodies, with trucks and equipment, for the Corporation. See "Official Notices" March 29th.

West Hartlepool.—April 15th. High and low-tension switchgear, for the Corporation Electricity Department. See "Official Notices" March 29th.

York.—April 12th. Two water-tube boilers, with superheaters, automatic stokers, economiser and pipework, for the City Electricity Department. See "Official Notices" March 22nd.

CLOSED.

Belfast.—The Committee has accepted the tender of the Reason Manufacturing Co., Ltd., for demand indicators for the year.

Bolton.—The Electricity Committee has accepted the tender of the British Insulated and Helsby Cables, Ltd., for wire and cables required for the fittings department during the next 12 months. The electrical engineer was authorised to obtain tenders for 12 months' supplies for the works department.

Bradford.—The T.C. Electricity Committee has accepted the tender of the Paterson Engineering Co., Ltd., for an oil eliminating plant for feed-water purification, for the Valley Road Works, at £605.

Epsom.—The U.D.C. has accepted a tender from the Diesel Engine Co., Ltd., for an oil engine for the electricity works, at £3,721.

Ilford.—The Council has accepted the tender of the Electrical Apparatus Co., Ltd., for electricity meters for 12 months.

Leyton.—The tenders of Messrs. Headland & Headland and Messrs. E. H. Grimshaw & Son have been accepted by the U.D.C. for carrying out electric light repairs at schools on the west and east sides of the G.E. Railway respectively, for a period of 12 months.

London.—Poplar.—The B.C. Electricity Committee reported having received the following tenders for plant required for extensions at the main generating station:—

Two 1,000-kw. rotary converters.—General Electric Co., £3,599, alternative £3,795; British Westinghouse Co., £3,983; Siemens Bros. Dynamo Works, £4,146: Dick, Kerr & Co., £4,992; British Thomson-Houston Co., £7,453. Motor converters.—Bruce Peebles & Co., £4,360.

Switchgear.—Crompton & Co. (low-tension only), £714; Electric Construction Co. (incomplete), £1,800; Johnson & Phillips (not in accordance with specification), £2,066; Switchgear & Cowans (incomplete), £2,179; Ferranti, Ltd., £2,562, alternative £2,462; British Westinghouse Co., £2,608, alternative £2,357; British Thomson-Houston Co., £2,789; Reyrolle & Co., £2,356.

In regard to the tenders received for the two 1,000-kw. converters, the Committee stated that motor-converters had been installed in all sub-stations except Orchard Place, where two small rotary

converters of the Westinghouse type were installed in December last. For simplicity in starting and switchgear generally, the motor-converter had advantages over the rotary, which is, however, less costly. The rotary converter for 50 cycles, had made rapid strides in general construction and reliability during the past five years, and the electrical engineer reported that he had every reason to believe that the machine of this type recently installed would give every satisfaction, but he advised that, before deciding upon rotary converters for all future extensions, more actual experience should be obtained. He therefore recommended, in this instance, that one rotary converter and one motor-converter be obtained, and that the Council should be guided by the practical results of such installation in providing for future standardisation. The General Electric Co., the Committee continued, offered the lowest tender for rotary converters, but up to the present time this company had not built any machine approaching the size required. The engineer could not recommend the placing of an order experimentally, in view of the serious trouble experienced in the past with the early type of converters; and having regard to the much longer and greater experience of the British Westinghouse Co. in the manufacture of rotary converters, he suggested acceptance of the tender of that firm. Messrs. Bruce Peebles & Co. were the makers of motor-converters, and, although the guaranteed efficiency was not so high as in the case of rotaries, all the latest-type machines had been thoroughly reliable and had given no trouble. In accordance with the engineer's suggestion, the Committee recommended the acceptance of the British Westinghouse Co.'s tender for one 1,000-KW. rotary converter, at £1,991, and the tender of Messrs. Bruce Peebles and Co. for one 1,000-KW. motor-converter, at £2,130.

The Committee, reporting on the tenders received for the switchgear, stated that of those complying with the conditions specified, those of Messrs. Ferranti, Ltd., and the British Westinghouse Co. were the lowest, and the engineer suggested that in order to comply with the latest and most up-to-date practice, gear on the electrical remote-control system, as tendered for by these firms in their alternative schemes, with the heavy type switches be adopted, and that switches capable of dealing satisfactorily with a load of 20,000 KW. be installed on all extensions to switchgear at the main station, such switches to be fixed in the existing battery room. The advantages of the type of gear proposed were stated to be (1) immunity from personal danger during examination and overhaul; (2) minimum fire risk; (3) heavy type desirable in view of bulk supplies to other authorities and (4) modification of existing switchboard, with consequent risk, expense and delay, obviated. Of the alternative tenders of the firms in question, that of the British Westinghouse Co. was the lowest, and was reported also to embody the most practicable scheme. The Committee therefore recommended the acceptance of the tender of the British Westinghouse Co. at £2,357. The Committee had also accepted the following tenders:—Babcock & Wilcox, Ltd., main steam, feed and blow-down pipes, £728; Strachan & Henshaw, telpher coal-handling plant, £2,337; New Conveyor Co., lantern roof over new bunkers at generating station, £441. At the meeting of the Council these recommendations were agreed to.

Battersea.—The B.C. has accepted the tender of Messrs. Belliss and Morcom, at £7,187, for carrying out extensions to plant at the central generating station.

L.C.C.—In order to avoid delay, the Education Committee has been authorised to accept tenders for the electric lighting of Morden Terrace and Lyham Road schools during the Easter recess. The Highways Committee will also settle the contract for rolled-steel bar for magnetic brake shoes during the recess.

Sunderland.—The T.C. has accepted the tender of the A.E.G., Berlin, for the supply of a turbo-alternator, condensing plant, &c., for £13,475. This was the lowest tender, the next being for £16,425; the estimated cost was £16,400.

Northampton.—The T.C. has accepted the tender of Messrs. Keliher & Co. for a supply of 50 sets of tramcar destination screens, at 3s. 3d. each.

Warrington.—The T.C. has accepted the following tenders:—

Jas. Howden & Co., Ltd.—Two spare armatures for turbo-alternator condensing plant.
Brush Electrical Engineering Co.—Transformers.
British Westinghouse Co., Ltd.—Direct and alternating-current motors.

Wrexham.—The Electricity Committee has accepted the following tenders:—

Arc lamp carbons.—General Electric Co.
3 and 5-ampere electrolytic meters.—Bastian Meter Co.
10-ampere miniature electrolytic meters.—Reason Manufacturing Co.
Boiler solution.—W. G. Tranter's Boiler Co.

York.—The Electricity and Tramways Committee of the T.C. has accepted the tender of Messrs. Siemens Bros., Westminster, for overhead gear, &c., for an electric locomotive, at £207.

FORTHCOMING EVENTS.

Smoke Abatement Exhibition.—Until April 4th inclusive. At the Royal Agricultural Hall, London.

Institution of Electrical Engineers (Scottish Local Section).—Tuesday, April 9th. Meeting at Edinburgh.

Association of Engineers-in-Charge.—Wednesday, April 10th. At 7.30 p.m. At St. Bride's Institute, E.C. Paper on "Some Notes on the Use and Calibration of Electrical Instruments," by Messrs. G. E. Elphinstone and W. Phillips.

Leeds Association of Engineers.—Thursday, April 11th. At 7.30 p.m. At 5, Park Lane, Leeds. Annual meeting.

NOTES.

Legal.—Gott *v.* Veritys, Ltd.—At the Birmingham Assizes, Nisi Prius Court, on March 27th, after several previous hearings, Mr. Justice Lush delivered judgment in this case. According to the *Southall and Norwood Gazette*, plaintiff, Arthur Edward Gott, a mechanical and electrical engineer and inventor, of Southall, sued defendants, seeking to recover damages for breach of contract. "The plaintiff's case was that it had been agreed between him and the defendants that the latter should manufacture and sell certain patented articles of which he was the inventor, and pay royalties in respect of them. After some time the defendants, without giving three months' notice to the plaintiff, in accordance with the agreement, discontinued the manufacture and sale of the articles. It was alleged that they substituted others with the object not only of avoiding the payment of royalties, but of preventing the patents being worked elsewhere. It was stated that the case should stand or fall on one of the patents, his Lordship stating at the previous hearing that if he held there was no breach upon that one patent judgment would be entered for the defendants. If he held there was a breach, the action would be referred to the Official Referee to see if there were any further breaches and to assess damages. His Lordship now said he had come to the conclusion that there was a breach of agreement with regard to one of the patents; and by mutual agreement between the parties the case was referred to the Official Referee to decide whether there were any other breaches and to assess damages."

Campbell *v.* Oban Council.—This action, taken by John Campbell, gasfitter and electrician of Oban, against the Provost, Magistrates, and Council of the Burgh of Oban, has recently been before Sheriff Wallace. According to the report of the matter in the *Oban Times* of March 30th, his Lordship, who after the debate on the preliminary pleas made avizandum, issued on Thursday last week his decision on these pleas. The Sheriff repelled pleas one, two, and three stated for defenders, and continued the cause for further procedure till the Vacation Court on April 17th next, and meantime granted interim interdict as craved. At the close of a lengthy note, he says, that on the whole matter he is of opinion that the pursuer has alleged a sufficient title and interest to sue, and that the action, so far as it alleges patrimonial loss by pursuer due to defenders' actings in *ultra vires* of their statutory powers, is competent and relevant. Further, it appears that no question of really relevant or vitally essential facts is disputed in the case, the question in controversy being one solely of law and of the defenders' powers under the Acts and their Order to engage in the supply of electric fittings to the detriment of pursuer's business and to his patrimonial loss. "No doubt defenders deny that they are engaged in the business or trade of selling or supplying electric fittings. But they admit that they have been in the habit of supplying, and no doubt intend to continue supplying, their customers or persons who take their supply of electric energy from them with the fittings and adjuncts incidental to the use of that supply; and that, it appears to me, is sufficient admission on their part to enable me to decide the real question in controversy between the parties without further delay and expense. I think, therefore, no good purpose could be served by allowing a proof."

Salford Corporation and South Lancashire Tramways Co. *v.* Eccles Corporation.—In the House of Lords on March 29th, their Lordships had before them an appeal from the decision given in the Court of Appeal in May, 1910, in which the judgment given by Mr. Justice Eve in January, 1910, had been reversed. The question raised related to agreements for running powers over a section of tramway in Eccles and Salford, which gave through communication between Manchester and Liverpool. The proceedings in the Appeal Court were fully reported in the Electrical Review for June 3rd, 1910, page 898, and in their decision of last week the House of Lords confirmed the judgment of the Court of Appeal there set forth, and dismissed the present appeal.

'Bus and Tram Accidents in London.—Mr. Kellaway asked the Home Secretary last week whether his attention had been called to the fact that during the five years 1907-11, 305 persons were killed by motor-omnibuses in the metropolitan area, and only 127 by mechanically-propelled tramcars, although the tramcars carried nearly twice as many passengers as the motor-omnibuses; whether he was aware of the suggestion repeatedly made by Dr. Waldo, Coroner for the City and Southwark, that many of these fatalities would be avoided if motor-omnibuses were fitted with a safety tender similar to that which the Board of Trade insists on being fitted to mechanically-propelled tramcars; and whether he proposed to take any action. Mr. McKenna, in reply, said that the Commissioner of Police had from the outset impressed upon proprietors of motor-'buses the importance of providing a suitable guard, and had intimated to them that when one was available certain concessions would be made as to the minimum road clearances of these vehicles. No satisfactory device, however, of the nature indicated had yet been submitted to him. The safety tender on tramcars, suitable as it was for a vehicle running upon fixed rails, was not suitable for a vehicle meeting frequent inequalities of road surface.

London Aviation Meeting.—From the Graham White Aviation Co., Ltd., the proprietors of the London Aerodrome, Hendon, N.W., we have received full particulars of the events that are to take place at the forthcoming first London meeting at Hendon on Good Friday, Saturday and Easter Monday, and the conditions and regulations controlling them.

(*Continued on page* 551.)

SOME RECENT BÖVING WATER-TURBINE PLANTS.

It is difficult to judge whether the builder of water-turbines is more indebted to the builder of electrical machinery or *vice versa*. It is enough to say that it is only the advances in electrical practice which have made it possible to develop water-power in more or less inaccessible places and to convey energy to the spot at which it can be utilised.

Since the days—about 20 years ago—when the first hydro-electric distributing stations were being installed in Switzerland, enormous strides have been made, both as regards size of units and range of falls utilised. Units of 15,000 B.H.P. are not uncommon, and heads up to 3,200 ft. have been harnessed, turbine efficiencies of 86, and even 88, per cent. have been obtained, and the difficult problem of automatic regulation satisfactorily solved; in fact, the construction of the hydraulic turbo-motor may be said to have reached a stage where very little room remains for improvement, and which is marked by the definite triumph of two types of turbine only: the Francis turbine for low and medium heads, and the tangential impulse wheel.

The great advantage of the Francis type — under which name are comprehended all radial inward flow, semi-axial outflow reaction wheels—over the older types, Jonval, Girard, Fourneyron, &c., lies in its wonderful adaptability to all conditions of head and speed.

The various Francis wheels in fig. 1 encompass the widest range of possibilities in this respect. The narrow wheel on the right hand side is the "slow runner," as used for comparatively high heads; the large one on the left hand side is a "quick runner" working at high speed under a low head.

It would be difficult to exaggerate the importance of the quick runner in modern turbine practice; it is applied for nearly all the plants of the open-flume type, *i.e.*, for heads up to 40 ft. (or even more for very large units).

As a concrete example, it can be said that 15 years ago the maximum possible speed for a 1,000 H.P. single turbine with 20 ft. head was about 65 R.P.M.; nowadays 108 R.P.M. is easily reached. Whilst in the old days the speed had to be increased by the introduction of gear wheels or belt drives, direct-drive is now the rule in hydro-electric plants.

The firm in Europe which stands foremost as builders of "quick-running" Francis turbines are the Kristinehamn Works of Messrs. Jens Orten-Böving & Co.

Owing to the conditions in Sweden, where nearly all the falls are between 5 and 35 ft., they had to give their attention quite early to the difficult problem of designing high efficiency quick runners, and five to six years ago they were already supplying standard quick runners with a "specific speed" of 355 R.P.M., whilst the big Continental firms had not yet built runners for more than 300 R.P.M.

It is interesting to note, for instance, that the Böving Co. were the only European firm in a position to quote for the plant of the City of Winnipeg, on account of the high speed stipulated. They secured the whole contract for five double generator turbines of 5,300 H.P. running at 164 R.P.M., and two exciter turbines of 450 H.P., all with automatic governors. At the tests the large turbines were found to give 5,800 H.P.

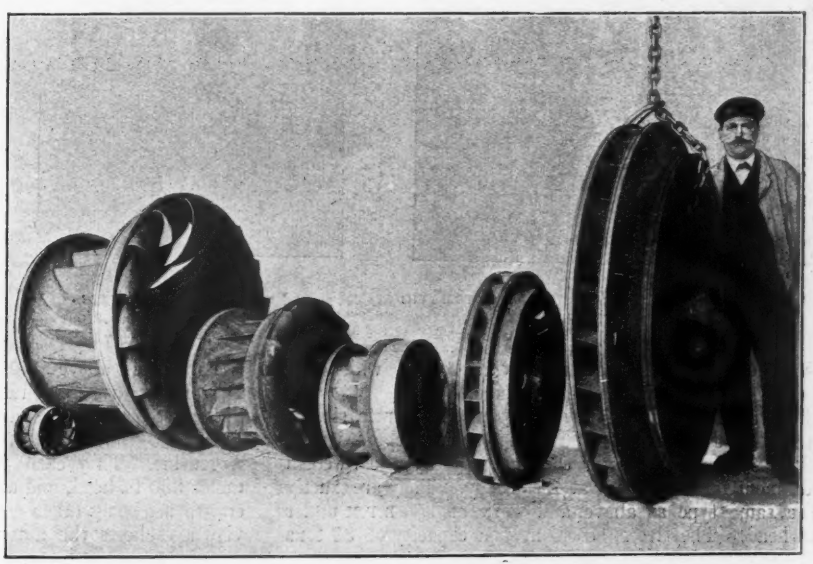


Fig. 1.—Francis Wheels; Low Heads to comparatively High Heads, Left to Right.

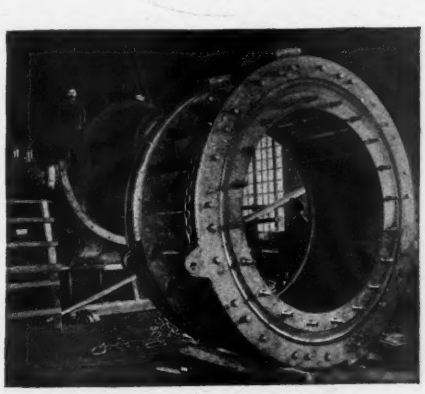


Fig. 2.—Distributing Wheel and Runner, Winnipeg Power Plant.

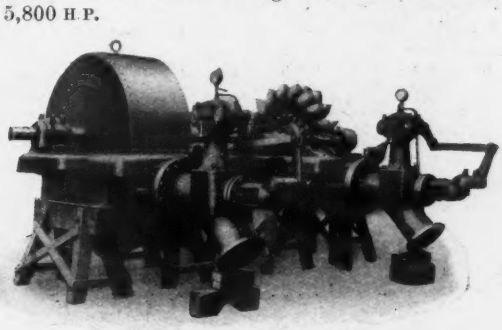


Fig. 3.—Impulse Turbines for Argentina.

Fig. 2 shows one of the distributing wheels with runner and discharge casing in the background. The power station is at Point du Bois, on the Winnipeg River, about 75 miles from Winnipeg, and is already built complete for an ultimate total output of 75,000 B.H.P. The head is 45 ft.

A good idea of the considerable dimensions of Francis turbines for low heads is given by fig. 7, showing one of

the six generator-turbines of 4,000 H P. (4,500 H.P. on test), supplying current to the Domnarfvet Iron Co., of Sweden, for smelting iron ore by the use of Gronwall reduction furnaces, the patent rights for which furnaces are held by Electro-Metals, Ltd., a company controlled by Messrs. Jens Orten-Böving & Co. The turbines work under a head of 33½ ft. and run at 187 R.P.M. They each consist of four runners, discharging in pairs in common suction casings, the whole being erected in an open flume. The funnel in the middle

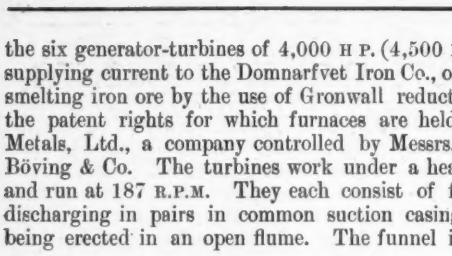


Fig. 4.—Francis Spiral Turbines: Automatic Governor in foreground.

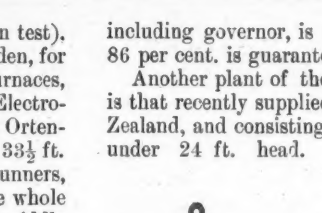


Fig. 5.—Single Spiral Turbine, 3,300 B.H.P.

gives admission to a water-tight chamber in which are placed the ring lubricated main bearings.

These machines are, however, of quite moderate size if compared to the three 14,000-B.H.P. turbines, the order for which has just been given the company by the Swedish Government for their plant at Elfkarleby. They are exactly of the same type as above, and work at 150 R.P.M under 53 ft. head. They have, accordingly, a capacity of 88 tons of water per second each, and are easily the biggest low-pressure turbines in the world. Each of the four runners has an outside diameter of about 8 ft. The turbine shaft, of nickel steel, is hollow and in four lengths, with forged coupling flanges; its length is 75 ft., and the diameter in the main bearing is 17 in. The weight of each turbine, including governor, is about 300 tons, and an efficiency of 86 per cent. is guaranteed.

Another plant of the same type—four-fold open flume—is that recently supplied to the Waihi Gold Mining Co., New Zealand, and consisting of six turbines of 1,500 H.P. each, under 24 ft. head. These are, however, considerably smaller, the shaft length being only 53 ft.

Fig. 6 shows one of the turbines installed in the Swedish Government's power house at Trolhättan. These machines are of the Francis double type, and are enclosed in steel plate casings with axial inlet (removed in the view). They are rated each 12,500 H.P. (13,300 H.P. on test) under 100-ft. head with a speed of 180 R.P.M. Most of the castings are of steel on account of the pressure. There are three main bearings, one on the generator side in front of the casing and two inside same, at the back of the turbine, and between the two runners respectively, accessible through inspection shafts. They are all of the ring-oiled type, with four and two rings.

For heads above 100 ft. up to 350 or even 500 ft., Francis turbines in spiral casing are generally used. Fig. 4 illustrates one of three turbines which have just been erected at the Rio Lules plant of the Tucuman Hydro-Electric Co., Argentine. They each develop 1,800 B.H.P. at 600 R.P.M. under 330 ft. head, and are of the single-discharge type, the end-thrust being taken care of by a special bearing. The view also shows the automatic oil pressure speed governor which is of an absolutely self-contained type, with rotary oil pump and air vessel.

A smaller machine of the same type was shipped recently to New Zealand for the New Plymouth municipal plant; it is designed for an output of 420 B.H.P. under 120 ft. head. The speed is 750 R.P.M.

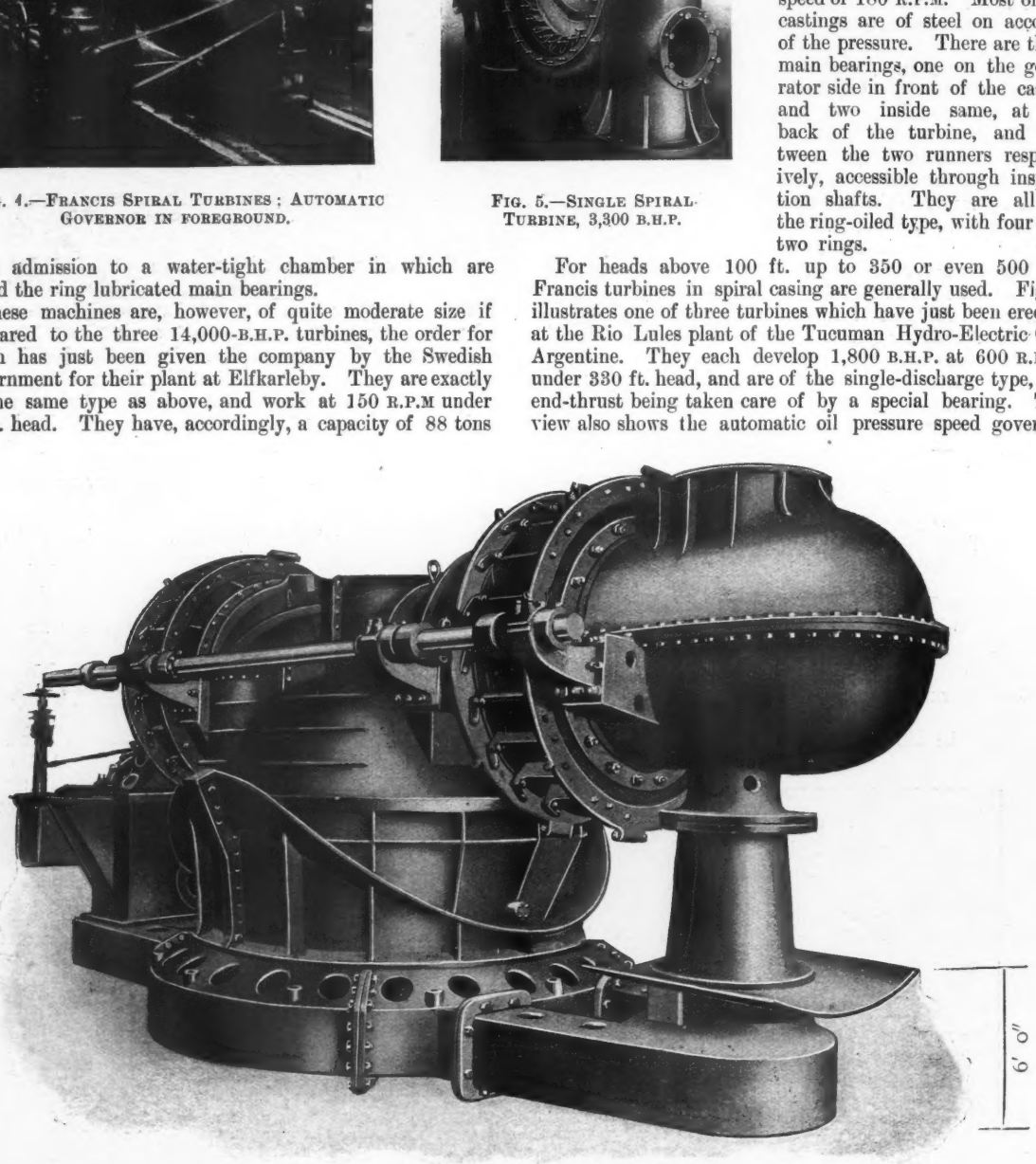


Fig. 6.—Francis Double-Type Turbine of 12,500 H.P., Trolhattan.

Fig. 5 shows a large single spiral turbine which has been in operation for some time at the Stangfjord plant of the British Aluminium Co., in Norway. It develops 3,300 B.H.P. under 290 ft. head when running at 300 R.P.M. The wheel is 53 in. in diameter, and, as far as we are informed, this is a record dimension in Europe for such a high head.

As manufacturers of high-pressure impulse wheels, Messrs. Jens Orten-Böving & Co. have also an interesting record; firstly, on account of the size of some ef the plants, and, secondly, by the reason that the manufacture of large impulse wheels of more than 1,000 H.P. is entirely new to this country. They shipped a few weeks ago from their works at Oakengates to Japan a double impulse turbine of 1,550 B.H.P., which is the largest water turbine ever manufactured entirely in British workshops. They have also just started the manufacture of two large impulse turbines of 5,000 H.P. each, to operate under 1,000 ft. head.

Fig. 3 gives a good example of impulse turbines made at the firm's works at Oakengates. This shows two units which are exciter machines of 200 B.H.P. for the Rio Lules plant, Argentine, the generator turbines for which are described above. Three exactly similar machines each developing 450 B.H.P. are being at present manufactured to the order of the Indian Government for their plant at Simla.

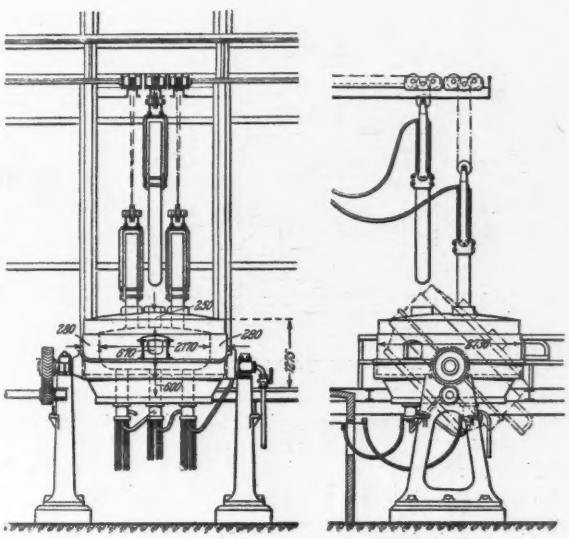
A NOVEL ELECTRICAL STEEL FURNACE.

[BY OUR BERLIN CORRESPONDENT.]

In designing the electrical steel furnace described here, Dr. H. Nathusius endeavoured to combine the individual advantages of the Héroult and Girod furnaces, without the drawbacks of either.

It will be remembered that in connection with the Héroult furnace two carbon electrodes of opposite polarity are introduced vertically through the roof into the melting compartment. After entering the slag and metal bath through one electrode, the current traverses the charge on its surface, leaving it through the second electrode. The heating effect thus mainly occurs at the surface, which has some advantages as well as disadvantages, the former being due to the very hot and chemically active slag thus produced, while the excessive heating which the charge has to undergo in order to raise the bottom and walls of the furnace to the proper temperature, is an undoubted disadvantage. Furthermore, there is the mutual dependency of the two electric arcs, which, in some cases, is bound to prove disturbing.

In connection with the Girod furnace a principle first suggested by Siemens is utilised, the whole of the charge being in the circuit, as the current enters from the top through one or more carbon electrodes, passes on through the electric arc to the slag and metal bath, and after traversing the latter, leaves the furnace through water-cooled steel electrodes which project through the hearth bottom as far as the steel bath. In this case, the current traverses the whole of the steel bath which serves as a heating resistance, a method which is especially advantageous in the melting of solid charges. While the electric arc starting from the carbon electrode produces a local heating of the slag, there is no extensive heating comparable to the surface effects in the Héroult furnace.



Arrangement of Nathusius Electric Steel Furnace.

In the Nathusius furnace, which is of the combined arc and resistance type, there are three surface carbon-electrodes penetrating vertically into the hearth compartment, at the corners of an equilateral triangle; these electrodes are connected to the outside terminals of a three-phase generator or transformer, and three steel electrodes in the bottom (also arranged at the corners of an equilateral triangle) are joined to the same three-phase generator or transformer, the furnace charge itself forming the neutral

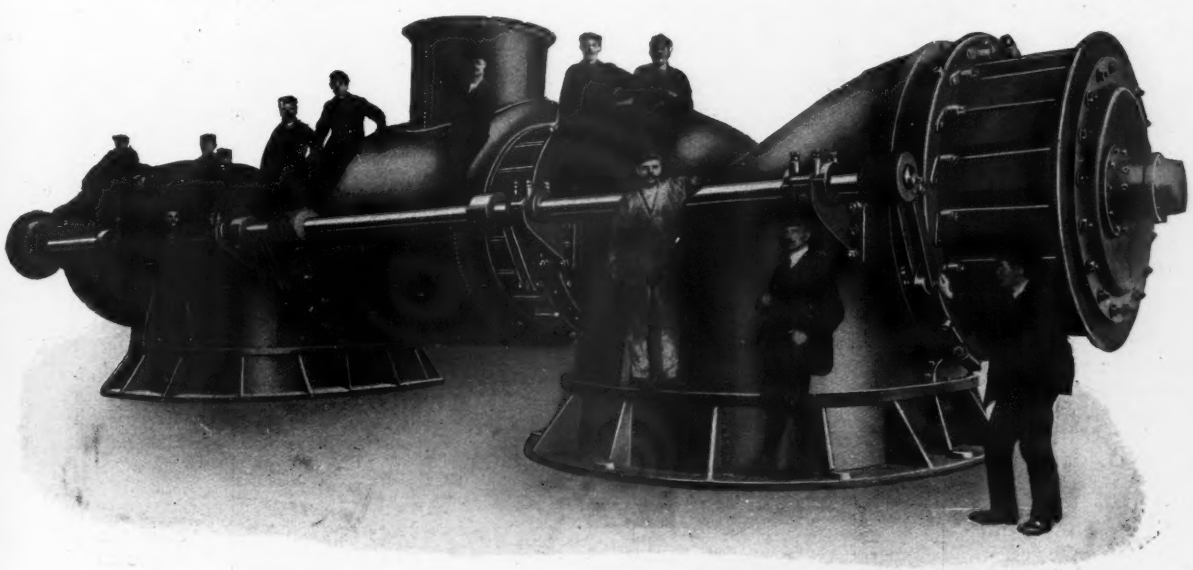
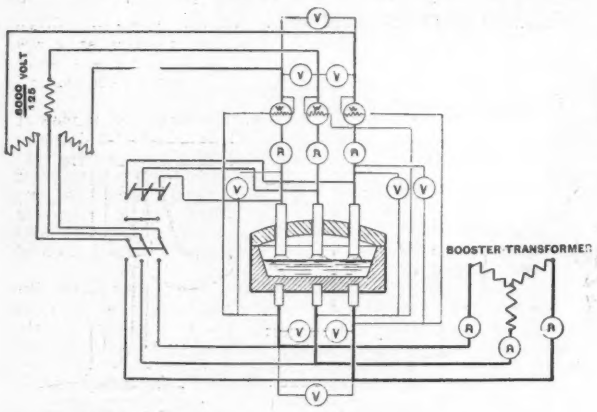
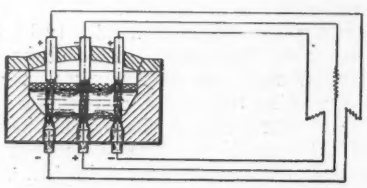


Fig. 7.—Francis Turbine with Four Runners for 33½-ft. Head, developing 4,000 H.P.

point of the latter. As both the upper and lower electrodes are of mutually alternating polarities, the current passes from one surface electrode to another, from one bottom electrode to another, and from each surface electrode to one of the bottom electrodes. In fact, there is inside the charge a perfect concentration of currents, instead of the surface currents of the Héroult and the cross currents of the Girod furnace. This heating process by which the whole of the charge is traversed and encircled by heating currents is obviously as economical as can be desired.



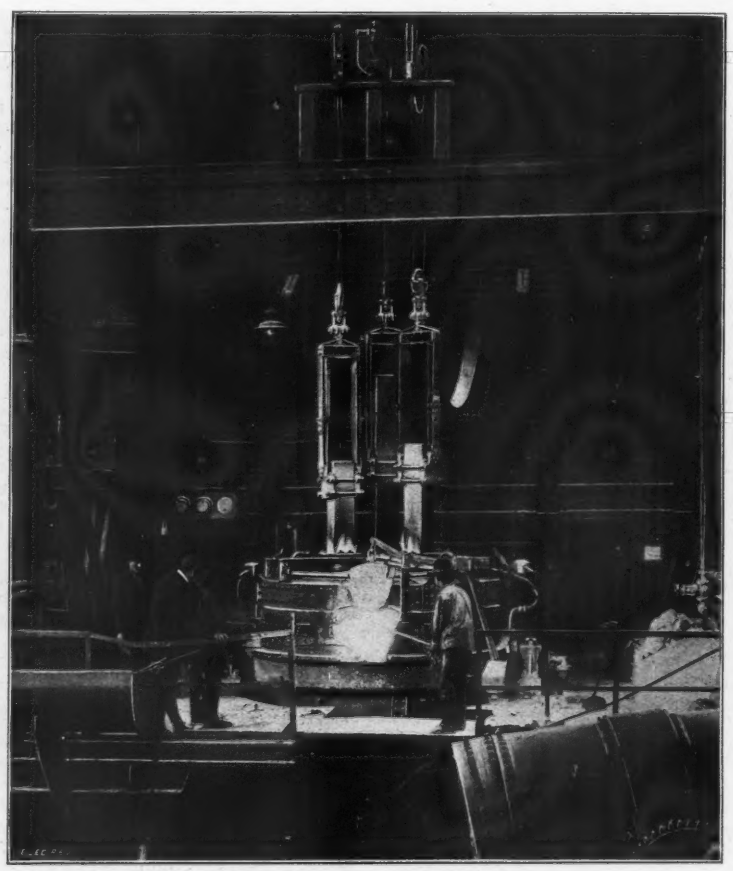
Arrangement of Connections.



Arrangement of Electrodes.

Further, it is well known that round each current traversing the iron bath there are formed rotary fields which, as in the case of a three-phase motor, will set the surrounding iron parts rotating. With the Héroult furnace this rotation only occurs at the surface, while the Nathusius furnace is traversed throughout the bath by dense current lines, setting up everywhere whirlpools, which, apart from a very uniform heating, ensure an excellent mixing of the material and a perfect uniformity in the final product.

Again, the Nathusius furnace heats much more rapidly than furnaces with only two heating centres, and, as the surface electrodes are placed as close to one another as possible, the electric arcs will repel each other in virtue of the electrodynamic repulsive forces exerted by the currents.



The Nathusius Electric Steel Furnace.

As three-phase current is employed in practically all large metallurgical works, its use is a further advantage, while the problem of including the charge in the circuit is solved most ingeniously by locating the neutral point in the bath itself, and the process is independent of resistances. As the circuit comprises not only the electric arc, which varies continually, but also the slag layer, the steel bath and the mass rammed upon the bottom electrodes, any shocks produced by short-circuits in the electric arc are compensated as though by an electric buffer, thus dispensing with any furnace regulation in normal operation.

A further advantage from the electrical point of view is that the current flowing from one bottom electrode to the other is easily regulated by a special generator with adjustable neutral conductor, or by a booster transformer. As this current only flows between the bottom electrodes, and therefore through relatively small resistances, it can be increased without any risk of using under-loaded machinery of excessive dimensions.

While during the first stage of operation (the refining stage) effective heating of the slag (the only refining agent in the electric furnace) by intense arcs is of much importance, it should not be overlooked that during the ensuing deoxidising stage the slag is only a protective cover, and accordingly requires no strong heating. During this second stage the whole of the bath should, therefore, be heated as effectually as possible, which, in the Nathusius furnace, is done by using a booster transformer, and thus deriving from the electric arc a considerable amount of energy concentrated in the bath or the bottom.

After once preparing the charge it is often desirable to allow the bath to rest for some time, during which stage the amount of heat to be added only corresponds to the heat lost by radiation and conduction; this is effected by allowing current to flow only between the bottom electrodes, and thus doing away with arc heating. The furnace thus affords during the last stage of the process a good equivalent of the crucible furnace process, which is of especial importance for the quality of the final products. All the electrical apparatus (measuring instruments, &c.), are installed in a special room, protected against dust and heat, whence a ready view is obtained of the furnace. The surface electrodes are suspended from ordinary cables, by pulleys and rails, being rapidly lifted in tilting the charge by means of high-speed motors, and inserted immediately the furnace returns to its normal position.

The furnace is pivoted in the same way as a steel converter, and the tilting device is operated electrically or hydraulically. The bottom electrodes, which are made of cast-steel, do not penetrate into the steel bath, and are covered by a layer consisting of the same material as the floor. The whole of the furnace, exclusive of the lid, consists of a rammed dolomite mass, and is exceedingly durable.

NOTES.

(*Continued from page 546.*)

Inquiries.—A correspondent asks for makers of Crawford car replacers for grooved rails, and "Peerless" coil-winding machines.

The B.E.A.M.A. and the Electrical Trades Benevolent Fund.—The Olympia Electrical Exhibition was a decided financial success, and owing to the new method of management, the net profits passed automatically into the hands of the British Electrical and Allied Manufacturers' Association; these profits have been ascertained to amount, after paying rebates both to the ordinary exhibitors and a special rebate to the members of the Association who exhibited, to over £3,500, and part of the profits has been paid over by the Exhibition Executive Committee to the B.E. & A.M.A., who are naturally utilising it for their ordinary requirements and propaganda. When the Exhibition was first commenced, it was stated, so we are given to understand, that the profits from it would be devoted to the benefit of the electrical industry. It will, therefore, be interesting to ascertain what persons should be considered in the application of these surplus funds. The larger proportion of the space for which rent was paid in the Exhibition, whether reckoned by size or by money value, was occupied by firms who were not members of the B.E. & A.M.A., but who contributed in various ways to making the event so great a financial success.

On previous occasions when electrical exhibitions have been held under the auspices of the National Electrical Manufacturers' Association, which has now been taken over by the British Electrical and Allied Manufacturers' Association, the profits, after paying all the expenses, have been allotted to charitable purposes, and the Electrical Trades Benevolent Institution consequently enjoyed a contribution from the profits of the Olympia Electrical Exhibition in 1905, of £650, and also a very substantial sum from the Manchester Electrical Exhibition in 1908.

The Electrical Trades Benevolent Institution, although quite separate now from the B.E. & A.M.A., is still the deserving offspring of the predecessors of that Association, and two-thirds of its Committee are members of the B.E. & A.M.A. Owing to the reorganisation and new powers of voting introduced in the Manufacturers' Association, the present Council is very widely different in character to that of any previous Councils of the Electrical Manufacturers' Association, and it may be that some of its members are not conversant with the origin of the Electrical Trades Benevolent Institution.

Under the articles of association of the B.E. & A.M.A., Clause 3, Sec. N, it has full powers to make grants to charitable organisations, &c., connected with the industry, and it will be particularly appropriate on the present occasion, when the realised surplus from Olympia has been nearly twice the anticipated surplus, that a donation of, say, £500, should be freely given to the Electrical Trades Benevolent Institution. A Committee has been formed to consider the matter, but it has not yet come to a decision. We learn that many of the members of the Council have expressed themselves favourably disposed towards the Benevolent Institution, but have decided to await the report of this Committee. One member of the Council, however, seems to have raised objections, and bases these objections upon the introduction of the National Insurance Act. Some people conversant with this Act hold that it will not assist materially to lighten the burden that the Benevolent Institution has taken upon its shoulders; it will not be applicable to quite a large number of cases where ill-health is the controlling factor, and it will never be applicable in the cases where the recipients have been in superior positions.

The B.E.A.M.A.—We are informed that the second Council meeting of the British Electrical and Allied Manufacturers' Association (Incorporated) was held at the offices, 36, Kingsway, London, W.C., on March 21st. The following members were present:—A. Bruce Anderson, chairman (Ferranti, Ltd.); F. R. Davenport (Willans & Robinson, Ltd.); F. C. Gibbons (Browett, Lindley & Co., Ltd.); C. Koettgen (Siemens Bros. Dynamo Works, Ltd.); B. Longbottom (Electromotors, Ltd.); F. H. Nalder (Nalder Bros. & Thompson, Ltd.); E. S. New (D.P. Battery Co., Ltd.); M. J. Railing (General Electric Co., Ltd.); W. Rutherford (Dick, Kerr & Co., Ltd.); W. O. Smith (Elliott Bros.); A. D. Williamson (Vickers, Ltd.); A. P. Wood (Lancashire Dynamo and Motor Co., Ltd.). The following firms were elected "Members" of the Association:—The British Electric Plant Co., Ltd., Alloa, N.B.; the Osram Lamp Works, Ltd., London; Robertson Electric Lamps, Ltd., London.

The secretary, having reported applications for the Association's patronage of certain proposed exhibitions, was instructed to send to members the letter of which a copy is given herewith.

The secretary further reported that the exhibition proposed for 1912 by Bradford Corporation would not take place this year. A report upon the Association's recent action in the case of West Ham Corporation was approved. The following reports of progress were read and adopted:—(1) "Model general conditions of contract"; (2) sectional meetings; (3) conferences; (4) the Electric Lighting Acts: Bill for further powers. The Publicity Committee was constituted a Standing Committee for conference with the Electric Supply Publicity Committee and other purposes.

Copy of letter *re* Exhibitions:—

"We have been approached from several quarters as to the participation of our members in Exhibitions which are being promoted under the name of Electrical or "Smoke-Abatement" Exhibitions.

"The feeling of the Council of the Association is that, in view of the very large expense which electrical manufacturers incur in promoting their own triennial Exhibitions, it is not desirable that they should be called upon to bear to any extent the expense of various local exhibitions throughout the country; nor do they see that any good purpose is served by incurring such expense in carrying and exhibiting heavy machinery which is only of interest to those people who are, as a matter of fact, already fully acquainted with such various manufactures.

"On the other hand, they appreciate to the fullest degree the necessity of the electrical industry demonstrating to the public, as far as possible, the superiority over gas or coal of electrical appliances for domestic and other purposes. For this reason, the Council are of opinion that such members who manufacture any apparatus which it is desirable should be exhibited to the general public should be at liberty to do so.

"I shall be glad to know, therefore, if it is your desire to exhibit any such apparatus at any of the proposed Exhibitions enumerated below, and, as soon as I am in possession of the names of the firms who wish to exhibit, I will endeavour to make the best possible terms for those manufacturers, on collective lines.

"The first experiment in this direction has been made at the Smoke-Abatement Exhibition at the Agricultural Hall, London, which opens to-morrow, and it will doubtless interest our members to see that exhibit.

"D. N. Dunlop, *Secretary.*

"*March 22nd*, 1912."

Place.	*Promoters.*	*Dates.*
Birmingham.	City of Birmingham.	Oct. 7th-26th, 1912.
Glasgow.	Corporation of Glasgow.	Sept. 20th—Oct. 12th, 1912.
Newcastle.	Newcastle Exhibitions, Ltd.	(Not yet fixed).

Wages and Prices in New Zealand.—Referring to some remarks in a leading article in our issue of March 22nd, "A New Zealander" writes to say that wages and prices in New Zealand are compared with those in England to illustrate a preceding statement. The object of the illustration is obvious, but the means used to emphasise that object are calculated to convey an entirely wrong impression of living in New Zealand:—"The word 'artisan,' I take it, includes bricklayer, plasterer, carpenter, joiner, fitter, turner, &c., and for each of these I can furnish the usual wage paid in New Zealand.

"Bricklayers and plasterers are paid from 11s. to 18s. per day of eight hours (working week of 48 hours). Carpenters and joiners at the rate of 10s. 8d. to 12s. 6d. for the same time as the first mentioned. Fitters and turners from 11s. to 12s. 6d., also for the same time.

"With reference to rent, I am perfectly satisfied that whatever manner of house the Englishman can rent for 5s. per week, the Colonial can obtain just such another in New Zealand for 7s. 6d., with the difference that, inasmuch as a large city in that Colony consists of 50,000 inhabitants, the house mentioned would most probably be much nearer to the city, and turn out the cheaper of the two because of the difference in car or train fares. With regard to boots, I will furnish to any reader addresses of firms in New Zealand, where he may be supplied with boots of the 10s. English standard at 12s. 6d. per pair and satisfaction guaranteed. I have found living in London to be much more expensive than the same standard in New Zealand, where I have resided over 20 years; in some of the provinces it works out in about the same ratio as the prices of boots as above."

Educational.—An Exhibition of the work of students of engineering in London, organised by the London County Council, was opened last week at the Whitechapel Art Gallery by Mr. Cyril S. Cobb, chairman of the L.C.C. Education Committee. A special feature of the Exhibition is the collection of engineering drawings and designs from King's College, University College, and East London College.

Parliamentary.—Second and Third Readings.—In the House of Commons, on March 26th, the London Electric Railway Bill was read a third time. The Preston, Chorley and Horwich Tramways Bill passed its second reading.

In the House of Commons, on March 29th, the Metropolitan District Railway Bill was read a third time.

Fatality.—According to the *Daily Mail*, through receiving an electric shock at 6,000 volts, a youth named Shapcott was killed at a North Finchley tramway station, where he was an electrical assistant. "Accidental death" was the verdict at the inquest held on March 27th.

Appointment Vacant.—Station superintendent, for the Corporation Electricity Works, St. Helens (£170). See our advertisement pages to-day.

Institution and Lecture Notes.—Physical Society.—At the meeting held on March 8th "A Method of Making Capillary Filaments" was exhibited by Mr. H. S. Souttar, F.R.C.S. The apparatus demonstrated was designed by the author in 1901, and recently has been applied to the construction of fibres for the string galvanometer. The essential part of the apparatus is a small box of mica, between the upper and lower plates of which a fine platinum wire is strung backwards and forwards so as to form a small cage enclosing a cylindrical space 1 cm. in diameter and 2·5 cm. deep. On passing a current through the wire it can be heated to redness, and the box is converted into a small furnace. A small glass tube is hung in the centre of the furnace, and supports a small weight. As the glass softens the weight falls, and the glass is drawn out into a fine capillary. The weight is a long light rod with a disk on its lower end, which nearly fits a tube into which it falls. The tube is filled with a mixture of glycerine and water, with the result that the weight falls smoothly and evenly till it reaches a stop. It is easy with this appliance to draw down a tube of 1 mm. external diameter into a tube of any length, and of a diameter of 0·001 mm., with a wall less than 0·0001 mm. in thickness. As the thick ends remain attached to the filament it is easy to manipulate. The filaments are exceedingly light, 10 cm. of such a thread weighing, roughly, 0·1 milligramme. They are exceedingly strong, such a thread supporting a weight of at least 0·05 gramme, corresponding to a tensile strength of, roughly, 100 tons to the sq. in. The tubular form exposes a large area for silvering, and the resulting conductor has a low resistance.

Mr. R. S. Whipple stated that the Cambridge Scientific Instrument Co. had given up quartz fibres in favour of glass ones for use in string galvanometers. Glass fibres could be silvered much more easily than quartz ones.

Mr. W. Duddell said he was greatly interested in 1897 in string galvanometers in connection with wireless telegraphy, and constructed one with a narrow strip of gold leaf. Such a filament about 0·25μ thick by 2 or 3μ wide made a string of extremely low rigidity.

Institute of Marine Engineers.—The annual report shows that the membership is now 1,284, an increase of 56. The City Premises fund amounts to £4,567. The revenue account shows a credit balance of £159, and the total assets amount to £4,178.

Institution of Electrical Engineers (Birmingham Local Section).—The meeting that was fixed for April 17th has been postponed.

The Association of Mining Electrical Engineers (North of England Branch).—A meeting was held at Armstrong College, on Wednesday, April 3rd, when Mr. F. Milburn read a paper on "Underground Lighting with Low-Voltage Metallic-Filament Lamps." Discussion was to follow, time permitting, on the paper on "Motor Starters for Mining Work," by Mr. A. P. Drake, B.Sc.

Post Office Telegraphs and Telephones.—The financial statement of the Postmaster-General for 1910-11 presented to Parliament last week showed that the net revenue of the telegraph service was £5,121,342 and the expenditure £6,085,166, showing a deficiency of £963,824—the largest deficit ever recorded. The amount received in royalties, mainly from the National Telephone Co., was £342,542, and the amount paid to cable companies, foreign countries, &c., was £781,487 (deducted from the gross revenue). Of the expenditure, salaries and other working costs amounted to £4,721,158, and items of the nature of capital outlay to £1,036,321. The total expenditure, apart from the latter, was £5,048,845, or £72,497 less than the total receipts. The figures are exclusive of the capital expenditure on the purchase of the telegraphs, &c., which amounted to £10,129,687; the interest paid on this account was £271,691, which brings up the total deficiency on the telegraphs for the year ended March 31st, 1911, to £1,235,515.

The capital expended on telephone purposes to March 31st, 1911, was £11,130,327. The total capital expended on both telegraphs and telephones, including sums spent on extensions, &c., is given as £29,293,289.

The total deficiency in the telegraph account from the commencement is £19,821,381; excluding items of the nature of capital from the expenditure, the deficiency is reduced to £7,942,226, but in this no charge is made for interest on capital expenditure not provided by the issue of stock or the creation of annuities.

The total expenditure on trunk telephone lines was £5,337,725, and on exchanges £3,913,204 in London, £1,691,619 in the provinces. The telephone revenue was £1,595,787, and expenditure £1,146,629, leaving a balance of £449,158, which, added to the royalties above mentioned, fell short by £262,187 of the amount necessary (£1,053,887) for the repayment of principal, interest, &c., on outstanding loans.

Osram Lamps.—The General Electric Co., Ltd., announce that they have now decided to withdraw the 5 per cent. extra charge which has hitherto been charged for Osram lamps required for series burning.

Printers' Rifle League.—The Electrical Review Rifle Club, which entered Division II of this League for the season 1911-12, finished fourth. Twelve teams competed in each division; no other technical paper was represented.

An All-Electric Scheme.—According to the *Daily Telegraph*, the city of Boston, U.S.A., is preparing to carry out a scheme on the lines advocated by Mr. Ferranti. It is hoped that electricity generated on the coalfields of Pennsylvania, some hundreds of miles away, will in a few years be transmitted to Boston, and enable all coal fires, chimneys, and other objectionable accompaniments of combustion, to be abolished.

Social Events.—The staff of Messrs. Marryat & Place gave a smoking concert, on March 25th, at the Old Bell Restaurant, Holborn. Mr. H. Marryat presided. During the evening there were brief addresses by Mr. Huddell, the chairman, and by Mr. Lock, who voiced the thanks of the meeting to Mr. Marryat for presiding.

On Friday, March 29th, the employés of the Bradford Corporation electricity works department held their annual social and dance, at the Peel Park Hall, in connection with their Sick and Benevolent Fund. Messrs. F. Birch and Alf. Dickinson proved efficient M.C.'s over the dance and whist drive respectively. We are told that good music, numerous prizes and splendid refreshments were all conducive to the success of the event. The attendance of over 100 couples indicates the increasing popularity of these annual gatherings, and also the capable manner in which the Socials Committee, including Messrs. Railton, Holt, Laidlow and Richmond carried out their work.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements*

Central Station Officials.—Mr. H. R. Dobson, chief show-room attendant and representative of the Harrow Electric Light and Power Co., Ltd., who is leaving the Company's service to take up the position of District Representative to the St. Marylebone Borough Council, was the recipient of a handsome present subscribed for by the members of the staff. The presentation was made at the offices of the Company on Saturday last by the engineer and manager, Mr. J. A. Bernard Horsley, who in handing Mr. Dobson the present, referred to the good work done by him during his long connection with the Company.

The Gillingham Corporation has advanced the salaries of Messrs. R. H. Lee and C. Fritton, shift engineers, by three annual instalments of £6 10s. per annum to a maximum of £91 per annum.

The salary of Mr. Gray, borough electrical engineer of Accrington, is to be increased from £350 to £400.

The Willesden Council has appointed Mr. A. W. Blake as electrical engineer in place of Mr. Bruce, who is leaving for Buenos Ayres. Mr. Blake was borough electrical engineer of Monmouth from 1899 till 1906.

The Electricity and Tramways Committee of the Newport (Mon.) T.C. on March 28th decided to recommend Mr. A. Nicholas Moore for the appointment as borough electrical engineer. Mr. Moore has for 4½ years been chief assistant engineer to the Belfast Corporation Electricity and Tramways Department. There were 97 applicants.

Mr. Kenneth F. Bishop's recent appointment at Warrington was to the position of mains superintendent, not shift engineer, as previously stated.

Tramway Officials.—The following salary increases have been sanctioned by the Manchester Corporation:—Mr. J. Wood, financial superintendent of the tramways, from £450 to £475; Mr. J. T. Oakes, traffic superintendent, from £425 to £450; Mr. F. A. Mitcheson, accountant, from £350 to £375; Mr. H. Mattinson, permanent way engineer, from £350 to £375; Mr. Blackburn, rolling stock superintendent, from £325 to £350; Mr. R. Beattie, chief claims clerk, from £300 to £325; Mr. G. W. Hancock, parcels superintendent, from £275 to £300.

Mr. G. A. Baxter has been appointed traffic superintendent to the Darlington Corporation tramways.

The Oldham Corporation Tramways Committee last week considered the appointment of a works superintendent at the depôt. There were 70 applications for the position. The Committee appointed Mr. Theodore Gerrard, employed by the British Westinghouse Co., Manchester.

The special committee appointed by Northampton T.C. to go into the duties and salaries of the Council's various employés recommends, among other things, the increasing of the salary of Mr. Gottschalk, tramways manager, from £340 to £360 per annum, rising by two subsequent annual increments of £20 each to a maximum of £400.

General.—Among those presented to Her Majesty the Queen by Prince Alexander of Teck on the occasion of her visit to the Middlesex Hospital last week, was Mr. A. Murray Coombs, the consulting electrical engineer.

Mr. H. Charles Gover, who has been secretary of the Edison and Swan United Electric Light Co., Ltd., since 1882, having been with the company all through its existence, retired from the position on March 31st. He will carry with him at the conclusion of this unique record in the electrical industry the good wishes of a host of friends.

Mr. J. E. Lloyd Barnes was on Saturday last presented, at the Central Technical School, Liverpool, with an illuminated address by his old students, on relinquishing his position as lecturer in electrical engineering. Mr. J. Wemyss Anderson, Dean of the Faculty of Engineering at Liverpool University, in making the presentation, mentioned that Mr. Barnes was the first to found an evening laboratory class in electrical science in the provinces.

CITY NOTES.

British Insulated and Helsby Cables, Ltd.

The annual meeting was held on March 25th at the Exchange Station Hotel, Liverpool, Dr. E. K. Muspratt presiding.

In moving the adoption of the report (see Electrical Review, page 475), the Chairman said, according to a report in a Liverpool paper, that trade generally throughout 1911 had been better than in previous years, and that the electrical industry had participated in this improvement. During the year they had been kept busy in all departments of the works, and, while no contract of exceptional magnitude or unusual profit had been obtained, each department had contributed its share to the increased profits. This remark specially applied to the recent additions made to the range of the company's manufactures, and, as at present advised, it was not the intention of the company to further increase the scope of its manufactures, but it would be necessary to extend several departments which were extremely congested with work, and orders had been lost due to the company's inability to supply the needs of the market. A change of considerable importance has been made during the year, the company having sold its Liverpool works to a new company, the Automatic Telephone Manufacturing Co., Ltd. The accounts before the shareholders did not show the changes in the company's balance-sheet made by this sale, as the transfer took place as from January 1st this year, and the profits on the working of the Liverpool business to the end of 1911 were included in the present balance-sheet figures. The primary reasons for accepting the offer of the Automatic Co., were that the Liverpool works were not of a size commensurate with the company's operations in other directions, as the telephone business of this company was a new creation, without any specialities or goodwill. Under these circumstances, it was found difficult to compete with other longer-established firms, and the directors felt the only way to meet the situation would be to get hold of some speciality, so that the business should not be entirely dependent on work which met with the keenest competition. A great change was impending in operating the telephone exchanges by the introduction of automatic working, dispensing with a large number of operators. Their general manager, Mr. Sinclair, being intimately acquainted with the telephone business, went to the United States to inquire into what had been done in that country in this direction and found that the Automatic Co. controlled a system which was working successfully. As a result of the fullest inquiry into every detail of the business, the arrangement mentioned was entered into. They had parted with their Liverpool works, but, at the same time, had retained a very considerable interest in them, and their directors felt confident that the profits to be earned under the new arrangement would be satisfactory. The Automatic Co. would, of course, be closely allied to the Helsby Co., and to ensure this the board had nominated the majority of the directors of the Automatic Co. The prospects were quite satisfactory. Referring to the balance-sheet, they had spent £44,416 almost entirely on plant and machinery at the Prescot and Helsby works. This additional expenditure was necessary to enable company to meet the ordinary requirements of the business and increase the output in some of the subsidiary departments. Against this capital expenditure, however, the amount written off plant and machinery as depreciation and the sums put to other reserves (not counting increased carry forward) amounted to £43,500, practically an equivalent amount. The stock and work in progress had increased by £40,600, due to the larger amount of trade done and work in hand at the end of the year. The sum for sundry debtors had been increased by £43,541 during the year owing to the growth of the business. With regard to investments, after writing off £8,500, the balance left was £552,193, as against £526,769 at the commencement of the year, being an increase of £25,424, which was almost entirely due to the requirements of the Midland Electric Corporation for Power Distribution, Ltd. They practically owned all the shares in this company, and its position had further improved during the year, and there was every indication of steady and continuous progress. With regard to the other company in which they were so largely interested, viz., the Electric Supply Co., of Victoria, Ltd., this company was doing better. Changes had been made in the management, and more remunerative prices were being obtained for the current sold, and as a consequence of this it was expected that a marked improvement would be shown in the near future.

Mr. J. S. Harmood Banner, M.P., seconded, and the report was adopted.

Callender's Cable and Construction Co., Ltd.—The directors announce (says the *Financier*) that the accounts for the year to December 31st show a balance to the credit of profit and loss account of £76,835, or £20,997 in excess of that for 1910. This, with the amount brought forward, £40,073, gives a total of £116,908. The payment of interest on debenture stock, dividend on preference shares, and the appropriation for depreciation of buildings, plant, &c., absorbs £32,127 of this amount. The directors propose to recommend a further dividend on the ordinary shares at the rate of 5 per cent., together with a bonus of 5 per cent., making, with the interim dividend already paid, 15 per cent. for the year. This will absorb £26,250, leaving to be carried forward £58,531.

Underground Electric Railways Co. of London.—The scheme for the acquisition by this company of ordinary stock of the London General Omnibus Co. became binding on March 26th. The new securities will be issued in exchange for deposit receipts on a date which will be advertised shortly.

Berlin Elevated and Underground Railway.

The report of the directors of the Gesellschaft für Elektrische Hoch und Untergrundbahnen, of Berlin, states that the year 1911 was of special importance to the undertaking in so far that it resulted in a certain conclusion of the years of negotiations in regard to the further development of the railway. On the completion of the network already sanctioned, the total length of the railway will be 20·7 miles, of which 14·38 miles will be underground, and the remainder will be of the elevated class. The construction of the new lines, and the alteration of existing lines, is to be accompanied by the adoption of far-reaching measures for the accommodation of connecting lines. As bearing on this point, it is mentioned that in the case of the Wilmersdorf-Dahlem connecting line of a length of 4·3 miles, suitable forms have been arranged in such a way that the local authorities concerned will remain the owners of the line, and retain the requisite influence on the construction and course of working, whilst a working community and fares agreement will be introduced with the lines of the Elevated Railway Co. The accounts show the following results for the two years:—

	1911.	1910.
Share capital	£2,500,000	£2,500,000
Gross profits	303,000	278,000
Interest on loans	80,000	68,000
Reserve for redemption and renewal of lines	48,000	40,000
City taxes	9,000	8,800
Depreciation	3,600	3,400
Net profits and balance forward	162,000	153,000
Dividend, per cent.	5½	5½

During the year the elevated and underground railway carried 62,585,512 passengers, as compared with 56,890,000 in 1910, and the average receipts per passenger were 13·05 pfennigs and 13·23 pfennigs in the two years respectively. In addition, the short flat or level line, which is equipped with 10 motor-cars and seven trailers, transported 2,020,000 passengers, as against 1,530,000 in 1910. The rolling stock of the elevated railway consists of 139 motor-coaches and 112 trailers. The balance of £500,000 of the loan capital was issued in 1911, and this raises the total loans to £2,991,000, whilst the sum of £375,000 is still outstanding of the total ordinary share capital of £2,500,000.

Prospectuses.—*Consolidated Diesel Engine Manufacturers, Ltd.*—The prospectus of this company has been before the public. The list opened on Monday, and was to close on Wednesday, 427,076 ordinary shares of £1 each (the whole of which have been underwritten) being offered for subscription at par. The company has been formed to amalgamate the businesses of the undermentioned firms and building new works at Ipswich for the manufacture of Diesel engines. The amalgamation will be effected by the acquisition of share capital of the Diesel Engine Co., Ltd., and half the share capital of Messrs. Usines Carels Frerés, S.A., and the businesses will be worked as mutually co-operating branches of a single undertaking. Dr. Diesel is a member of the board. A report by Prof. W. C. Unwin, on the outlook for the Diesel engine and its extending use for electric light and power stations, accompanied the prospectus.

Another prospectus before the public is that of the Burmeister and Wain (Diesel system) Oil Engine Co., Ltd., offering at par 500,000 six per cent. participating preference shares of £1 each. The oil engine installation on the *Selandia* was carried out by Messrs. Burmeister & Wain. The new company will erect large works in Great Britain for the manufacture of oil engines on *(inter alia)* the Burmeister-Wain system. The prospectus contains a good deal of information regarding the prospects for marine oil-engine work. Closing day, Thursday, April 4th.

Liverpool District Lighting Co.—At the annual meeting held on March 27th at Liverpool, Col. A. Hill Holme, the chairman, said that the company had come to the end of the years affected by the introduction of the metallic lamp which had given customers their normal amount of light at some 60 per cent. less expenditure of electrical energy. The decreased cost was now bringing more customers among the occupiers of small houses, who were finding that electric light need not cost more than gas if carefully used. The low cost of energy would enable them, he expected, to supply light to the new Seaforth House Home for the Aged Poor, and the Seaforth Barracks. They had already got the new board schools at Cambridge Road. Even the small houses now being built were wired for electric light. The use of electrical energy for cooking, laundry, dyeworks, and other purposes was also extending. There was every probability of a great new departure in the use of electricity. One gentleman of great business capacity and knowledge was anxious for the company to supply him with energy for all household purposes, so that he need not have a hundredweight of coal in his place. The profits of the past year were the largest the company had ever made. The company had nothing to do with politics, but instead of the old parties in the State, there were now a lot of people who openly declared their intention to rob and despoil all who had capital invested in such industrial concerns as their own. They wanted more capital, and could with great advantage spend £10,000 in laying mains that would increase their revenue, but they could not expect to obtain it as long as Socialism was the dominant spirit that ruled those who ruled the country.

Continental.—France.—The balance-sheet of La Société Hadraise d'Energie Electrique, of Havre, for the last financial year shows a net profit of £36,718, as compared with only £26,604 in the preceding 12 months.

Vera Cruz Electric Light, Power and Traction Co., Ltd.

Mr. Vincent W. Yorke presided on Wednesday last week at the fifth annual general meeting of the above company, which was held at 47, Parliament Street, London, S.W.

The Chairman, in moving the adoption of the report (see Electrical Review, page 515), said he was sure they would agree with him that the results shown by the accounts were fully satisfactory. The gross earnings of both the lighting and tramway sections showed steady regular increases with corresponding increases in the net revenue. They had been somewhat disappointed at the amount of power and light which the Vera Cruz Terminal Co. had taken from them under their contract with them, but they were hopeful that in the near future they would be in a position to call for a larger supply. He would like to remind them that the report of the engineers, which was issued with the prospectus of the debentures, stated that the net earnings in Mexico might eventually reach £28,000 per annum. It was a great satisfaction to them that within a period of some 18 months after that report they had been able to show an income within a few pounds of that estimate, and they still had the future with the natural growth that it should bring to the business to look forward to. The earnings for the past two months of 1912 showed an increase of over $10,000 Mex. on those of the corresponding period of 1911, and the prospects of the business generally appeared to be distinctly encouraging. The temporary steam plant, about which he told them last year, was completed and available for use, and they had made arrangements by which they hoped to be able to dispose of that plant at very little loss to the company as soon as they had at their disposal the supply of water-power from the Tuxpango Falls of the Puebla company. The contract which they were making with that company was not yet finally settled, but the negotiations were so far advanced that he thought they might conclude that no hitch in the arrangements was likely to occur, and that in about two years' time they would have at their disposal a large amount of power, and that without the expenditure of any capital on the part of the company. They had considered it wise to transfer from the accumulated profit balance a sum of £15,000 to depreciation and general reserve account before arriving at the amount which they recommended should be paid as dividend to the shareholders. That transfer was, he thought they would agree, a prudent step, but they must not think that the directors had considered it either necessary or advisable to deal with such an amount for depreciation alone. The depreciation on an undertaking like that, the property of which was kept in first-class condition and fully maintained, was not large, and that transfer had been made mainly with a view to establishing a reserve account before they began to pay dividends. He was glad to be able to tell them that the last reports received from Mexico indicated that political conditions generally were more normal. Private advices that he had received also indicated that the Provincial Government of the State of Vera Cruz had been particularly active and successful in stifling such outbreaks of disorder as had occurred in that State. They had had little or no trouble in Vera Cruz itself, and with the re-establishment of political peace the country ought to experience a great revival in trade in which they must, naturally, participate. He would like to express on behalf of the board their appreciation of the zeal and energy shown by Mr. Worswick, the general manager, and his staff in Mexico.

Mr. Newman, a shareholder, seconded the motion, and the report was adopted.

County of Durham Electrical Power Distribution Co. Ltd.

The annual meeting was held on March 27th at Newcastle-on-Tyne,

Dr. J. T. Merz, in moving the adoption of the annual report (see Electrical Review, page 475), said the company's total connections increased during the year by 4,455 H.P., which was rather more than they had to report in the preceding year. Their connections were increasing much more rapidly than their capital expenditure. Their profit last year was £32,031, an increase over the previous year of £3,325. They had also adopted the plan of writing off from the revenue account amounts which were set aside for improvements at the stations. These came to £712, and to that extent, therefore, the accounts were better. The consumption for lighting had increased by 103,792 units, and the total now stood at 1,149,000. The increase was not quite so much as in the year before. He explained that a large proportion of the lighting in Durham area was included in the figures of the power consumers. The large works got their current at an overhead price, and therefore the lighting figures were not shown. The capital of the company was the same. They spent £12,597 during the year, of which £6,203 was spent in mains, £5,744 in sub-stations, and £646 in motors and other sundries. As they did not increase the capital of the company, shareholders would want to know where they got the money from. They got it, first, from the depreciation, from the amounts they had written off; secondly, by reducing their stocks by £1,130; thirdly, by a better collection of their debts, which had given them some £5,000. The improvements in the profits of the company had enabled them to declare the full preference dividend of 5 per cent. against the 3¾ last year. The increase in the volume of business was promising up to March 1st, when the coal strike began. The increase was then 13¼ per cent., but this increase had been practically swallowed up by the loss in business during the last month, for, as they knew, a large number of their customers were collieries, and a large part of their supply had been taken off. At the same time they were, he thought, satisfied with the connection with them because they still consumed a considerable amount of power in order to keep the collieries in order. An important item was the connection that had been made between some new manufacturing companies and the Dunston station. One of these, a metallurgical works, was likely to consume a large quantity of energy. So far as the coal strike was concerned, their company was only indirectly interested because it got the whole of its supply from the Newcastle Electric Supply Company, and that company's works were well stocked with coal.

The report was adopted. A dividend of 5 per cent. on the preference shares was declared.

Mr. R. P. Sloan and Sir Lindsay Wood, Bart., were re-elected directors.

Newcastle-on-Tyne and District Electric Lighting Co., Ltd.

The annual meeting of this company was held in Newcastle on March 28th, Mr. A. Scholefield in the chair.

The Chairman, in moving the adoption of the report (see Electrical Review, page 471), said that the true position of the company, speaking generally, showed that the gross profit had increased both at Newcastle and at Lemington, and that the final balance-sheet exceeded that of any previous year. Some time ago they entered into contracts for coal for this year, and seeing what had happened since, and with prices ruling so high—which he was afraid would last for some time to come—he thought it was a matter for congratulation. Another favourable feature of the report was in regard to the arrangements made with the Newcastle Corporation for a period of 20 years to supply all electrical energy required for the Newburn tramway route. This was not yet completed, but he understood that it was expected that the trams would be working in six months' time. That would form a new and profitable undertaking for the company. They would remember the very serious losses that not only that company, but all electric lighting companies, had suffered from the use of the metal-filament lamp. He was pleased to say that they had now lived this down altogether, and were actually reaping a benefit from the cheapening of the system, for the low price of electricity was inducing more and more people to use it, and as time went on they would get more and more benefit. Another thing they would be glad to hear was that during the strike, when many feared that all power companies would have suffered, that company had not suffered at all. The demand so far during the strike period had actually increased both for power and lighting, and that showed the great provision the manufacturers on the Tyne had made for the strike. It was a matter of congratulation to the trading community that they should have anticipated the trouble in the coal world. They laid in stocks of coal and provided other material for manufacturers to carry on their trade. Other parts of England he knew had suffered losses, but, so far as that company was concerned, he was glad there had actually been an increase.

Col. W. M. Angus seconded, and the motion was carried.

The Chairman moved, and Mr. Brackenbury seconded, the declaration of a dividend at the rate of 3 per cent. per annum, which was carried.

The retiring directors and auditors were re-elected.

On the proposition of the Chairman, £50 was given to Armstrong College, Newcastle, and £21 to the Royal Victoria Infirmary, Newcastle.

Canadian General Electric Co., Ltd.—The report for 1911, as printed in the *Financier*, states that the profits amounted to $1,405,889, the largest in the history of the company, the recent additions to plant and equipment having permitted of manufacturing in greater volume without materially increasing overhead expense account. From this amount the directors have written off for depreciation $353,721, and have paid in interest on borrowed capital $162,422, leaving $889,745. Deducting from this amount dividends on preference and common stock at the rate of 7 per cent. per annum, amounting to $525,109, there remains a net balance of $364,636, which has been carried to the credit of profit and loss. This sum, added to the balance to the credit of that account at the end of the previous year, makes a balance of $675,779, which, together with the reserve fund of $1,669,531, makes a total surplus of $2,345,311. The volume of business transacted being much larger than in previous years, the current liabilities have necessarily increased, in order to take care of work in progress, but against these current liabilities the current assets amount to $7,926,840. During the year the company acquired the property and assets of the Sunbeam Incandescent Lamp Co., of Toronto, and contracts have been let for additions to the buildings and equipment which will double the capacity of this plant. A new stores building at the Peterborough works, 325 ft. by 80 ft., is being erected at the present time, and plans have been accepted for the erection of a new plant in Toronto for the ornamental iron, bronze and art metal department, the growth of which has surpassed expectations. The directors have passed a by-law providing for increasing the authorised capital stock of the company to $12,000,000, of which increase shares to the par value of $1,900,000 will be offered to all holders of ordinary shares of record on April 20th, 1912. The growth of the business renders this policy advisable, and the only extra charge to the company will be the difference between the rate of dividend paid to the shareholders and the rate of interest paid to the bankers.

Southport Tramways Co., Ltd.—The directors' report states that the accounts for 1911 show a surplus of £549. £500 has been transferred to reserve, and £49 is to be carried forward.

Potteries Electric Traction Co., Ltd.

Mr. G. F. M. Cornwallis West presided on Friday at the Electrical Federation Offices, Kingsway, W.C., over the meeting of this company.

In moving the adoption of the report (see Electrical Review, page 515), the Chairman said that although the dividend on the ordinary shares was not a large one, they might congratulate themselves on the year's working. It was a record year since the inception of the company, as their traffic receipts amounted to no less than £101,000, this being the first time they had touched six figures under this heading. The amount carried to the balance-sheet, which was, after all, the most important figure, was £35,500, as against £27,800 last year. They had carried nearly two million more passengers on approximately the same car-mileage, and when the small increase in working expenses was taken into account, he thought they would agree that the result was eminently satisfactory. He had hoped at the end of February to have been able to come before them and have prophesied an equal, if not still more prosperous, year, and even now he was not despondent, although like all other industrial and traction companies they had suffered from the coal strike. In fact, as they would have seen in the papers, the distress in the Potteries district, owing to this most disastrous strike, was very acute. At the commencement of the strike their receipts showed an increase of £790 over 1911, but this increase had been more than wiped away, and they were now actually down by about £750. This figure was, however, counterbalanced to the extent of about £500 by the natural decrease in their working expenses, so that assuming the coal strike was settled shortly, and the company continued carrying its normal amount of traffic and ran its normal mileage, they would be no worse off during the year under review. Their service had been an adequate one as circumstances required, and they had not reduced it owing to shortage of coal, which, in other words, meant that they foresaw what was coming. Now he was on the subject, he would like to say a word of gratitude for the loyal manner and uncomplaining way in which the staff had done their work. Owing to the reduction of the service, the employment they had been able to give had necessarily been reduced from 60 hours a week to about 35 hours per man—a hardship which, he need hardly say, they had been unwilling to inflict. The appreciation of the staff for so loyally working under these conditions, would be shared by the shareholders. Their parcels traffic had been of a satisfactory nature, and the profits showed an increase of £197. Advertising receipts remained as before, and the decreased return from their holding in the North Staffordshire Tramway Co. was counterbalanced by an increase in sundry receipts. The slight increase in general expenses and administration was highly satisfactory when compared with the large increase in the net receipts. Some years ago a policy was instituted by the board of ensuring that the permanent way should be kept up to a high standard of repair, and for this purpose a renewal fund was started, and last year they expended £10,413 under this head, as compared with £4,025 in the previous year. They had put no less than £12,000 to that fund this year. He was glad to say that they had had no complaint from the local authorities as to the condition of the permanent way, and the increased expenditure, a small proportion of which was chargeable to capital expenditure owing to the laying down of a heavier rail than was originally used, had more than justified itself. They had taken £2,000 from the reserve fund for the purpose of writing off motor 'buses, which had not proved a success, although they were the best they could purchase at the time. They did not consider, with the experience they had had, that they were suitable to the roads of the district. They paid back the £2,000 to the reserve fund that year so that the figure remained as before. The expenditure on capital account only amounted to £417.

Mr. S. Mear seconded the motion, and it was carried without discussion.

Mr. Croft, who subsequently seconded a vote of thanks to the board and the staff, complimented the board on having met a difficult situation this year, and expressed the appreciation of the shareholders at the conduct of the staff during the strike.

British Aluminium Co., Ltd.

The annual meeting was held on Thursday last week at Winchester House, E.C., Mr. A. W. Tait presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, page 515), said that the trading profit for the year, together with interest and dividend on investments and deposits, and the revenue derived from the Kinlochleven and Foyers estates, and transfer fees, was £152,902, as against £126,472 last year, an increase of £26,429. Those results were satisfactory considering the prices which had ruled during the period. The increase was due chiefly to the trading profit for the year, which had risen from £116,380 in 1910, to £140,378. The amount had been dealt with as follows: Provision for legal expenses, bad and doubtful debts, depreciation of furniture, and proportion of profits payable to directors, £13,407; prior lien debenture interest, £40,000; debenture stock service fund, £43,224; reserve for depreciation, £35,000; carried to reserve account, £17,269; leaving to be carried forward £4,002. The interest on the debenture stock for the year to December 31st, 1911, would be paid on April 1st. The amount of reserve for depreciation had been increased from £25,000 to £35,000. There had been added to reserve account the sum of £17,269, bringing that item to a total of £50,000. The amount allocated to reserve last year had been invested in securities outside the company's business, and it was the intention of the directors similarly to invest the amount allocated out of profits for 1911. This fund would form the nucleus of a liquid reserve which would be of the greatest possible advantage to the company in the future, as it would enable them to take advantage of favourable opportunities in the industry, or to weather periods of depression. The output and sales for the year were larger than in any previous year. This showed an encouraging increase in the demand for the metal, and they had every reason to believe that this increase would steadily continue. During last year the price of the metal was low, and in the latter part of the year a falling tendency was shown—not from any decrease in the demand, but owing to the policy adopted by foreign producers. This necessarily had its effect not only upon sales for immediate delivery, but also to a considerable extent upon the prices which were obtained for contracts spread over a year. He was pleased to say, however, that, since that time, prices had materially improved, and there was a reasonable prospect of still further improvement before the close of the present year. Although there was no fixed relation between the demand for aluminium and copper, the recent steady increase in the price of the latter was bound to have some effect on the demand for and price of aluminium. The fluctuations to which the market for aluminium was subject were due in a considerable measure to the capacity of the various works being in excess of the present consumption; but if the demand continued to increase in the satisfactory manner it had done in the past three years, there was every reason to believe that the position would shortly be greatly improved, and this would, no doubt, have its effect on the price which producers could obtain for their product. The rolling mills of the company had been well supplied with orders during the whole of the year, and it had been necessary to increase the plant to cope with the business. There had been a large increase in the demand for the motor industry, and the demand in the electrical industry for transmission lines, underground cables, and for switchboard connections was only just beginning, and was likely to extend rapidly. The works had been operating satisfactorily during the year, and the whole of the reduction works have been practically fully employed. Further plant has been installed at Kinlochleven to increase efficiency of working, being chiefly in connection with the carbon works, where they manufactured their own carbon electrodes for the electrolytic furnaces. The extensions to the plant at the alumina works at Larne have been completed, and they are now able to supply all the alumina required to keep the whole of the reduction works at Kinlochleven, Foyers and Stangfiord, in full operation. The company had carried out the programme for the provision of further large stocks of bauxite of good quality, which he outlined at the last annual meeting. The board considered this to be a prudent course, and authorised their subsidiary company, the Union des Bauxites, to complete the purchase, as the bauxite which was offered was of exceptionally good quality, and ensured to this company a continuous supply of raw material for many years to come. With regard to the Orsières power scheme, last year it was stated that arrangements had been made under which the company's rights were maintained and the existing works properly supervised to December 31st, 1912. Negotiations were in progress for an extension of the company' rights in respect of this scheme, and meantime, on the recommendation of the company's engineer in Switzerland, a certain amount of necessary development work would be proceeded with during the current year, which would also have the effect of reducing the charge in connection with the maintenance of the work which had already been executed. The balance-sheet clearly set forth the position at the end of the year. Property, buildings and and engineering works had been increased by the sum of £32,429, being the cost of additions during the year. The investments had increased from £527,167 to £571,256, largely on account of the bauxite matter to which he had drawn attention. The reserve fund investments now appeared as a separate item at £32,061. The investments were spread over a good selection of bonds, and he was pleased to be able to state that a valuation made at December 31st, 1911, showed that the depreciation amounted to a negligible quantity. He was afraid this might not have been the case if they had invested in trustee securities. The stocks of metal, raw materials and stores were almost the same as for the previous year, being £90,348, as against £86,940. There was, however, a considerable increase in the amount of sundry debtors. These had risen from £58,854 to £96,605. This was largely due to the increase in the company's foreign trade, and, in accordance with the contracts which had been made, payment for the metal was not due until 30 days after arrival at the customers' works. As this business was likely to continue, they might regard the figure shown at December 31st, 1911, as a normal amount, taking into consideration the volume of trade which the company was doing. Of the debenture stock an amount of £8,602 had been redeemed, and the service fund of £7,552 fell to be applied in respect of the year. The purchases in respect of this had already been made, and on or before April 30th a further £8,878 of debenture stock would be cancelled, bringing the total up to £17,480. The depreciation reserve account now stood at the figure of £60,000. The balance to the credit of profit and loss account, amounting to £4,002, had been carried forward, and, while the directors regretted they were not yet able to make payment of the preference dividend, they hoped the day was not far off when this could be done; but in view of the low prices which had been ruling for some time, it was felt to be the only prudent course to strengthen still further the position of the company. With regard to the coal strike, in view of the unrest exhibited for some time previous to the strike, they took the precaution to lay in stocks of coal at the various factories, and although this had only been done at considerable expense, it had enabled the whole of the works to

be kept in full operation until now, and it was hoped that they might be able to do so until the strike was over.

CAPT. S. H. POLLEN seconded the motion.

Replying to a SHAREHOLDER, the CHAIRMAN said he was fully in sympathy with what had been said as to the non-payment of the preference dividend, but it was clearly pointed out at the time the reconstruction scheme was put forward that it would seriously hamper the company if the cumulative rights of preference shareholders had been maintained. The board were very anxious to pay a dividend on the preference shares at the earliest possible moment, but in placing large sums to reserve, they were protecting the future interests of both classes of shareholders.

The report was adopted.

Puebla Tramway Light and Power Co.

CONCURRENTLY with the ordinary general meeting in Toronto a meeting of the above company was held at Winchester House, E.C., on March 28th, under the chairmanship of Sir Clarendon G. Hyde (president).

The CHAIRMAN, having explained that the company was a Canadian limited liability company constituted under the laws of the Dominion of Canada, carrying on its business in Mexico, but having by far the greatest part of its securities held in Europe, said his colleagues saw no reason why they should not annually meet the shareholders at an informal meeting, and give them that information by word of mouth to which they were entitled. Although in the name of the company the word "Tramway" figured prominently, they were all aware that the tramways were not at present the most important asset of the company. The company's main business was the generation and sale of electricity for lighting and power in the city of Puebla and the surrounding districts. Puebla claimed to be the second city of importance in Mexico; it had a population of over 100,000, and carried on many large manufacturing businesses, especially in connection with the cotton industry. The company had the contract for the city public lighting, and its successful method of illumination was constantly causing additional municipal demands for the extension of its services to other parts of the city. The company, since it started business in about 1906, had been supplying a yearly increasing quantity of electrical energy for light and power. The company's supplies of electrical energy up to the present had come from the Portezuelo Water Falls, some 14 miles distant from the city, and capable of generating 6,500 H.P. Recently, by the purchase of a local competing company called the San Agustin Co., another waterfall on the Rio Los Molinos, some 18 miles away, and capable of generating 1,000 H.P., had been added, making a total of 7,500 H.P. at the switchboard over the 24 hours, whilst with the reservoir at Portezuelo that company had a peak load capacity of over 11,000 H.P. Practically the whole of this H.P. had been sold, and the maximum development of the company had been almost attained, except by the addition of further H.P. from new sources. Under the company's concession with the city of Puebla it had, by August, 1913, to provide a minimum continuous supply of 16,500 H.P. available for sale within the city limits. It was, of course, out of the question in such a district as Puebla to consider the production of electricity by steam or oil when cheap water-power could be obtained. The company some years ago, before the present board assumed control, purchased concessions granted by the Federal Government for the utilisation of the waters of the Rio Blanco at Tuxpango, in the district of Orizaba, and of the Rio Atoyac, in the district of Cordoba. They were advised that the falls when fully developed would give a continuous power of 45,000 H.P. at the turbines, and would have a peak load capacity of some 70,000 H.P. Of course, at the present time they did not require anything like this quantity of power, but at the same time with the rapid growth of industries in Mexico, and especially in the Puebla district, it was not unreasonable to expect that in a few years' time the whole of this power could be commercially employed. For the present it was sufficient for them to add some 17,000 H.P. to the supply they had, basing the scheme of construction upon lines which would enable the subsequent harnessing of further H.P. by means of the addition of more units to a comprehensive and progressive scheme. The cost of the construction work with its transmission lines complete entailed an expenditure of approximately £300,000. They had also to provide about £150,000 for the purchase of the rival business of the San Agustin Co., whose installation had been handed over to them two years ago on their giving an undertaking to pay by June, 1913. They had also to provide for the repayment of certain moneys borrowed by the company to enable it to complete its underground extension work, and had therefore to finance a sum of over £500,000. To provide funds for these payments it was necessary for them to make immediate financial arrangements. Of the first mortgage 5 per cent. bonds there remained to be issued about 1¼ million dollars, say about £350,000 nominal, but the considerable discount at which these unquoted bonds were being dealt with entirely precluded them, as prudent financiers, from considering the sale of the remaining portion of the issue at anything like the price then current. There remained, therefore, only the expedient of issuing prior lien bonds, and in the report of 1910 they notified the shareholders of their intention to proceed by this method. Accordingly, under the powers contained in the trust deed of the first mortgage bonds, they procured the consent, in writing, of the holders of two-thirds of the bonds outstanding, to the creation of 6 million dollars 50-year prior lien 5 per cent. gold bonds, ranking in all respects prior to the first mortgage bonds. Of these bonds they sold £3,000,000 gold firm in December last, and, as a result, they had paid the price for the San Agustin Co., which purchase money was carrying a rate of interest which increased from year to year, and only now became economical to redeem, and they had funds in hand sufficient to enable them to complete the development of the Tuxpango Falls as far as they at present contemplated that work. The managing director and engineer, Mr. Worswick, was now engaged on the work of construction at Tuxpango. The tunnel was being driven from both ends; the necessary machinery was under order; the towers to carry the transmission lines were on the ground and were being erected, and so far as they could at present say, the work ought to be completed in about two years' time. Meanwhile, it was necessary for them to make sure that they could comply with their concession by bringing the requisite horse-power to make up 16,500 H.P. within the city limits by August next year. For this purpose, to ensure them having the necessary power available in any event, they had entered into a temporary arrangement with an industrial company owning falls at Orizaba, and having power in excess of its needs. Of the 17,000 H.P. which they were developing at Tuxpango, a considerable quantity would not at first be required at Puebla. They were therefore arranging to carry transmission lines not only from Tuxpango to Puebla (a distance of 78 miles), but in the opposite direction from Tuxpango to the Port of Vera Cruz (a distance of some 68 miles). At Vera Cruz there was an English company, the Vera Cruz Electric Light, Power and Traction, Ltd., with which they were intimately connected, and of which Mr. Worswick was also managing director. This company was carrying on at present a successful business, generating electricity by means of a Diesel oil engine plant with a temporary and auxiliary steam plant. The demands on the company were rapidly exceeding its available supply of energy, and it must in the near future add to its reserve. They were arranging a contract with the Vera Cruz Co., which would be at once economical and profitable to that company, and remunerative to themselves, by which they would be able to supply energy in bulk to the Vera Cruz Co. The tramways owned by the company, which were some 44 miles in length, were at present being worked by mule traction, and there was no obligation on the part of the company to electrify them, and the city tramways were on a different footing. They carried last year some 1,670,000 passengers. It was, therefore, probable that in the near future, as a result of negotiations with the municipality which had been pending for some time, terms might be arranged for converting an efficient, but somewhat out-of-date, system into the more modern outfit of electric traction. They had this year made a net profit in Mexico of £67,039, as against £61,607 for 1910, and £48,607 for 1909, and £27,354 for 1908. The net receipts for January and February this year showed gratifying increases on the same months of the preceding year. The only thing, in the opinion of the directors, which was required to ensure the continued success of the company was the return to normal political conditions in Mexico. Having referred to the exaggerated reports of the troubles in Mexico, which came from New York, the chairman said there seemed to the directors, who were in constant touch with Mexican affairs, good reason to believe that as soon as these political differences had settled themselves, and the nation turned once again to quiet development of its untold resources, there should follow a great revival in trade, coupled with a spread and growth of industries, which, especially in the district of Puebla, could only result in a greatly increased demand for light and power, with a consequent increase in the prosperity of this company. They carried forward a balance of £6,000. The directors did not hold out any prospect of a dividend until such time as the Tuxpango horse-power was connected and commercially dealt with; but there was no doubt that the yearly improvement in the company's position and earnings must mean, in the course of a few years, the creation of a great business and goodwill, which could only result in producing a good return to the shareholders of the company.

A formal motion by the chairman to receive the accounts was seconded by SIR G. S. ROBERTSON and carried.

Stock Exchange Notices.—Applications have been made to the Committee (1) to appoint a special settling day in and to grant a quotation to—

Constantinople Telephone Co.—50,000 shares of £T5.50 each.

(2) To appoint a special settling day in—

Bell's United Asbestos Co., Ltd.—60,000 6 per cent. cumulative preference shares of £1 each, fully and partly (7s.) paid (Nos. 140,001 to 200,000).

Canadian Western Natural Gas Light, Heat and Power Co., Ltd.—Fully-paid scrip for £811,643 5 per cent. first mortgage debenture stock.

And (3) to allow the following to be quoted in the Official List:—

Mexican Northern Power Co., Ltd.—$4,500,000 five per cent. first mortgage 30-year gold bonds, in lieu of the scrip.

Waste Heat and Gas Electrical Generating Stations, Ltd.—Further issue of 160,000 shares of £1 each, fully paid.

Oriental Telephone and Electric Co., Ltd.—The directors announce a dividend at the rate of 6 per cent. per annum on the preference shares for the half-year to December 31st, less income-tax, and a final dividend of 5 per cent. on the ordinary shares issued, free of income-tax, making 8 per cent. for the year.

Anglo-Argentine Tramways Co., Ltd.—A final dividend of 3¾ per cent. on the £2,500,000 ordinary share capital for the half-year ended December, 1911, less income-tax, is recommended, making 7¾ per cent. for the year, after placing £120,000 to the depreciation renewal funds, &c. £10,946 is carried forward.

South Metropolitan Electric Light and Power Co., Ltd.—Warrants for interest on the 4½ per cent. first mortgage debenture stock, for the half-year, were posted last week.

The Diesel Engine Co., Ltd.

The directors issued to the shareholders a circular letter dated March 27th, in the following terms :—

"It will have come to your knowledge that your directors have recently been engaged in negotiations for amalgamating the business of your company with that of the Usines Carels Frères (Société Anonyme) of Ghent, the world-renowned Belgian manufacturers of Diesel engines. These negotiations have resulted in an arrangement which your directors regard as eminently satisfactory, and which they have no hesitation in recommending unreservedly for the acceptance of the shareholders. The expanding demand for internal combustion engines is well known, and a moment has been reached at which the demand for such engines (and, indeed, for all engines requiring no coal) may be expected to expand at an accelerated rate. It is imperatively necessary that you should be in a position to meet and profit by this demand, which will otherwise go to building up the business of other manufacturers, while your own splendid opportunity will have been lost. To put the matter in a nutshell, your present undertaking is not big enough for the work that promises, and either it must be made big enough to secure work with the resulting profit, or else you must run the risk of seeing the business pass into other hands. The scheme which has been arranged by your directors to cope with this situation is, shortly, as follows :—

(*a*) A company with a capital of £750,000, divided into shares each of £1, will immediately be registered under the name "Consolidated Diesel Engine Manufacturers, Ltd." to control and extend the manufacture and sale of Diesel engines.

(*b*) 427,076 shares of the new company will be offered for public subscription at par. These shares have been underwritten.

(*c*) The new company will acquire half the share capital of the Belgian company (Usines Carels Frères S.A.), and one additional share therein, thus vesting the management and control of that company in the new company. The new company will, in return, pay to the shareholders of the Belgian company a sum of £150,000 in cash, and £100,000 in fully paid shares of the new company. The arrangement with the Belgian shareholders includes the supervision of the new company's works, and the training of its staff under experts from the Belgian factory.

The Belgian company owns an old-established business which has made very large profits, and it is the sound position of that company which enables the new company to secure on reasonable terms the large cash subscription which it requires.

(*d*) The new company will issue to each shareholder of the present Diesel Engine Co., Ltd., who assents to the scheme, one fully-paid £1 share of the new company in exchange for every two preference shares (each of 10s.) of the present company, and one fully-paid £1 share of the new company in exchange for every six ordinary shares (each of 5s.) of the present company, and will pay in cash 10s. for each odd preference share and 3s. 4d. for each odd ordinary share over and above exact multiples 2 and 6 respectively. Thus, if you assent to the scheme, you will receive fully-paid shares of £1 each in the new company, and cash in exchange for your present holding of shares in the existing Diesel Engine Co., Ltd. By means of these exchanges the new company will in effect become the owner, or substantially the owner, of the business of the existing Diesel Engine Co., Ltd.

(*e*) The balance of the cash subscriptions of the new company amounting (after paying all necessary preliminary expenses) to roughly £240,000, will be used in establishing a large new factory in a very convenient situation at Ipswich, and in generally extending the business of the amalgamated concern.

(*f*) Shareholders of the existing Diesel Engine Co. supporting this scheme will, if they desire to subscribe for additional shares of the new company, be given the preference in the allotment of shares therein.

"In the opinion of your directors, the scheme contains the promise of a highly successful undertaking. . . . A prospectus of the new company offering the above-mentioned 427,076 shares for subscription will be sent to you in the course of a few days. Your directors had intended summoning a meeting of the shareholders to explain the position, but events have moved too rapidly and time is now too valuable to permit of the delay that would be occasioned by so doing."

As announced on another page the prospectus of the Consolidated Co. has now been circulated.

Newcastle-on-Tyne Electric Supply Co., Ltd.

The annual meeting was held in Newcastle on March 27th, Dr. J. Theo. Merz, presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, page 471) said the connections to the system showed an increase of 11,851 H.P., as compared with an increase of 10,557 H.P. in the previous year. The total expended on capital account was £2,119,114. The cost per H.P. for the year had been reduced. It was only £6 10s. per H.P. connected ; in the previous year the connections cost £10 10s. per H.P. The net profit showed an increase of £7,059. The increase was really considerably more, because last year they benefited by interest received on moneys which they had got, and which they had not spent during the year. They made in that way £9,103, whereas in the previous year they got only £2,876. In addition to that, they had charged to revenue account an item which in former years was calculated in the amount provided for depreciation and reserve. These two items brought the increase of profit to something like £12,000, compared with £5,626 the year before. Thus the accounts, when dissected, showed better than on the face of the report. As he mentioned a year ago, the expenditure upon horse power connected was going down, and, in consequence, the profit on the horse power connected was going up. Some time ago, he told them that they expected to make about £1 profit per horse power connected, but that sum went down considerably owing to various causes. Last year the profit per horse power connected was 21s. 6d., whereas the year before it was only 14s. 6d., and in the year before that 16s., so that they saw that, while the capital expenditure on horse power decreased, profit increased. The lighting business was a scarcely less important portion of the company's trade, and that had considerably increased last year. They had sold 3,732,268 units, as against 3,469,596 units the year before, an increase of 262,673 units. The company had saved in coal 6·8 per cent. ; in the previous year the saving was 3·6 per cent., so that in the two years they had reduced the consumption of coal per unit produced by something over 10 per cent. In the year they had had to spend £2,495 more in rates, the rates on the Dunston station having come in for the first time, and there was an increase in the rates in Tynemouth Union in which area the Carville power station was situated. Referring to the Newcastle-on-Tyne Corporation Parliamentary Bill, he said that the shareholders would see that £8,054 had been put to the reserve. The Corporation for some time supplied their own current for the tramways in Walker district, but an agreement was made between the company and the Corporation, under which the latter paid the company a certain sum. The agreement ran out last year ; then the Corporation took up the position that the company's power ceased, while the company took up the attitude that they had the right to supply, and that there must either be a new agreement, or the company must be indemnified. The Corporation were anxious to supply their own tram service, and the point was included in their Corporation Bill, with the result that an agreement was come to that the Corporation should pay the company £12,250, which included a sum for the unexpired period during which the company had the right to supply the power for the trams. The chairman also referred to the fact that at Dunston two customers had put down works, one on the company's ground and the other on ground contiguous. One was a steam foundry and the other a metallurgical process that was expected to develop. These firms were really the customers of the Durham Electric Supply Co., but the Newcastle company benefited, as they had an agreement to supply the Durham company with all the current they required. The company were able to pay ½ per cent. more dividend than they did last year, which represented £3,500. The profits had increased by more than that amount, but the directors thought it safe and right to increase the dividend by only a slight amount, in the hope that they might increase it to similar extent another year. In regard to the coal strike effects upon the company, so far as they, as shareholders, were concerned, it was impossible so far to give them any exact figures or data, but the output in the previous week was as large as it was in the corresponding week of 1911, despite the stoppage at the pits, which were large consumers. Business had increased in other ways, and up to the present they had supplied their customers as usual, and the company intended doing so. He might mention that the amount of coal in stock was three-fifths of what the company had when the strike began. He would like to say that the favourable position the company was in, so far as supply was concerned, was very largely due to the foresight, diligence, and a great anxiety to do what was best, which had been shown by their manager, Mr. Sloan, and by the whole of his very able staff, including the advisory engineers. He took that opportunity, on behalf of himself and his colleagues, of thanking the staff for what they had done.

Mr. Hobart Armstrong seconded the report, and it was adopted.

The dividend resolution was also carried.

Mr. F. W. Dendy was eligible for re-election as a director, but he intimated, through the chairman, his intention of resigning his seat on the board, owing to pressure of business. The two other retiring directors were reappointed.

Windsor Electrical Installation Co., Ltd.—The annual meeting was held on March 20th, Sir W. Shipley presiding. The chairman said that the accounts showed a gratifying improvement over those of the past year or two, and the dividend was increased by a half per cent. He hoped that at future meetings they would be able to recommend further increases—subject to no further upheaval caused by labour troubles. While the revenue had increased by £150, the costs had been reduced by £690, due to the lower costs of the bulk supply and the great saving effected in their fuel bill by the Diesel oil engine. This engine had given such satisfaction that they had decided to order a second, which would be running in April. The Slough and Datchet Electric Supply Co. had installed similar plant at their works, which would result in lower cost of the bulk supply. The allocation to depreciation, renewals and reserve was £250 more than last year, and this year they would further increase the fund by transferring to it the balance of the dividend equalisation fund. An amendment that the dividend be 5 per cent. instead of 4½ per cent. was discussed at length, but was ultimately withdrawn and the report was adopted.

STOCKS AND SHARES.

Saturday Afternoon.

The incidence of the Easter holidays has made very little difference to Stock Exchange business. Once more the feature of the markets is the manner in which specialities have been singled out for particular attention, and, put colloquially, run to death. Such things as 'Bus stock, Marconi shares, Underground Electric issues, and City Lights have been centres of eager and excited dealings ; while, on the other hand, the broad volume of ordinary bread-and-butter trade is not on a very large scale.

It may be pointed out here that the quotations on the following pages are those of Friday night, March 29th, the Easter recess necessitating an alteration from the day upon which the prices are generally collected.

Prospects of peace in the coal world continue to have a very steadying effect upon Home Railway prices as a whole, but the grand features of the week have been the soaring of such securities as are connected with the underground transport of Londoners. The Central London trio has, however, ceased rising for the time being, though the big previous improvements are all maintained. City and South London gained ½, but the principal excitement is over Metropolitans and Districts, both of these shooting up at a rapid rate. The rise in Metropolitans was 3 points in the same number of days. Districts did still better, putting on 4½ to their quotation. Underground Electric issues are very strong also, the shares rising to 4 7/16 this, Saturday, morning. The Underground bonds remained at 89, and at that figure attracted a lot of buying. London General Omnibus stock has had a further sensational rise, and already this year has added something like 90 points to its quotation within three months. Fired by the rises in the Underground group, buyers pressed in for Great Northern and City Preferred Ordinary shares; and, finding their efforts to get hold of stock were unavailing, they ran the price up to 2½, at which it shows a nominal gain of 15s. There were, however, practically no shares about. So far as we can see, the Great Northern and City Tube lies outside the scope of the Speyer group, its principal hope of salvation lying in the prospect of its being taken over by the Great Northern line. However, the mere fact of its being underground, proved enough to send buyers flying into the market, with the result already detailed. East Londons have been rising also. The Ordinary jumped up 2 points, rising to 9½, while the three debenture issues have gone up several points as well.

Metropolitan Electric Tramways Ordinary have benefited to the extent of 7/16 by the issue of a report the other day showing the company to be making excellent progress. British Electric Traction issues are still very dull, and the London United Tramways descriptions have not moved.

The Electric Supply market is very steady on the whole, though there has been some natural profit-taking in the cases of City "Lights" and County ordinary. Considerable discussion is going on still as to the prospects of the Corporation taking over the City Company, either now or in 1914. On balance the price shows no quotable change, but the Preferences are slightly easier. County of Londons fell ¾, in consequence principally of the steady flow of new shares that was returned to the market by proprietors who preferred to sell their right to subscribe to the new issue. Upon this, the new dwindled to 5s. premium. It is said in the market that, as usual, some of the shareholders failed to exercise the privilege extended to them, so probably there will be a few left over for disposal at the discretion of the directors. Charing Cross have risen ¼, perhaps by reason of the hint given here last week; while St. James's are ¼ up, and London Electric have put on ¼. On the other hand, Westminsters shed 5s. of their recent rise. Metropolitans went back ½, and there are a few other minor declines which are not worth mentioning.

The feature in the Telegraph market once more is the extraordinary rise in Marconi shares, which has taken the price to more than double what it stood at in January. The buying is extremely persistent, nor is there much in the nature of a setback allowed to take place. The shares have come to be a very popular gamble, and possibly they are getting rather a dangerous one. In the train of the rise in the parent company, Canadian Marconis, after dropping back to 33s., went ahead to 38s. The special settlement is now taking place in the shares of the Spanish and General Wireless Trust Company, introduced not long ago to the market at the price of about 33s. 9d. The making-up price on Friday for the special settlement was 2½, after which it steadily mounted to 2 7/16, and is talked by its supporters substantially higher. Marconi new and Preference have, of course, followed the rise in the old shares. Another feature is the recovery in West India and Panama Telegraphs. Touching 4½ on Tuesday, there was a sharp recovery to 4¾. In the Eastern group there is not much going on, and prices are on the dull side.

National Telephone Deferred, upon fresh optimism with regard to the price at which the Government is going to pay out the company, rose 4½ points, the buying coming from various parts of the country. Other Telephone issues are merely quiet.

The Latin-Canadian group is steady to good. Rio Trams rose ¼, and this is said to be a preliminary to a big rise which is coming in them—this, by the way, being merely a market tip, to which no more importance is to be attached than to other advice of the same sort. British Columbia Electric stocks are good, the Deferred rising 3. Rangoon Electric Preference have come into favour on account of the good yield which they still return. Mexicans are steady, and show little change. Shawinigan Water rose 4½ points, and Kaministiquia Power bonds put on 2.

In the Manufacturing group a drop of 2½ lowered Willans and Robinson Debenture to 60, while General Electric Debenture fell 2 to 87½. Callender's lost half their rise of last week. Whispers went round to the effect that British Westinghouse stocks and shares were to go better; they had the effect of inducing a little buying, with the result that Preference shares are up to 5s., and the 4 per cent. Debenture gained a point.

Jarrow and District Electric Traction Co., Ltd.—The directors report that the accounts for 1911 show an available sum, after providing for debenture interest, and placing £700 to permanent way renewals account, of £2,657. The directors have declared a dividend of 2 per cent., and added £275 to depreciation and reserve account, carrying forward £633.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
†Aberdeen	Mar. 20	1,187	+ 1	42	62,095	+ 3,460	14·4	..
†Ayr	„ 23	193	+ 12	45	13,295	+ 168	8	..
†Bath..	„ 20	679	+ 17	12	8,086	+ 324	14·75	..
‡Birkenhead ..	„ 24	996	+ 28	51	52,183	+ 2,256	13·68	..
Birmingham Corp.	„ 23	20,611	+6,834	51	464,686	+108,149	56·4	..
†Blackburn	„ 20	298	+ 87	51½	58,363	+ 4,621	14·68	..
Blackpool Corp. ..	„ 28	796	— 5	..	64,009	+ 7,766	11·87	..
†Blackpool-Fleetw'd	„ 25	268	+ 19	11	3,198	+ 265	8	..
Bournemouth ..	„ 27	3,187	+ 317	52	90,691	+ 1,495	21·95	..
Bradford	„ 23	10,605	+1,079	51	276,944	+16,500	56	1·2
†Brighton	„ 24	785	+ 14	51½	51,328	+ 2,755	9·5	..
†Bristol	„ 22	5,716	+ 418	..	71,858	+ 6,481	30·5	..
Brit. Elec. Trac. Co.								
Airdrie	„ 22	606	+ 187	12	3,270	+ 780	3·65	..
Barnsley	„ 22	282	— 140	„	1,492	— 4	..	..
Barrow	„ 22	647	+ 188	„	3,621	+ 932	5·37	..
Devonport	„ 22	1,000	+ 155	„	5,707	+ 82	8·35	..
Gateshead	„ 22	1,974	+ 11	„	14,706	+ 146	11·25	..
Gravesend	„ 22	396	+ 36	„	2,286	+ 227	6·5	..
Greenock.. ..	„ 22	1,586	+ 366	„	8,293	+ 1,297	7·25	..
Hartlepool	„ 23	458	+ 23	„	2,709	+ 243	6·72	..
Kidderminster ..	„ 23	187	+ 14	„	1,051	+ 89	..	..
‡Leamington	„ 22	287	+ 31	„	1,711	+ 108	..	..
Merthyr	„ 22	316	— 46	„	2,172	+ 32	2·9	..
Metropolitan	„ 22	16,624	+1,185	„	96,114	+ 7,451	23	..
Middleton	„ 22	601	+ 31	„	3,256	— 11	8·5	..
Mid. Joint Com'tee	„ 22	6,168	+ 410	„	34,519	+ 1,242	..	..
Oldham—Ashton ..	„ 22	1,154	+ 118	„	6,402	+ 380	9·13	..
Peterborough ..	„ 23	222	+ 13	„	1,326	+ 168	5·81	..
Potteries	„ 22	3,766	—1,081	„	21,533	— 888	29	..
Rothesay	„ 22	104	+ 13	„	589	+ 78	3·75	..
Southport	„ 22	504	+ 52	„	2,722	+ 75	8·17	..
S. Metropolitan..	„ 22	1,542	+ 197	„	8,250	+ 334	..	..
Swansea	„ 22	2,1 5	+ 74	„	12,751	+ 626	12·5	..
Tynemouth	„ 22	338	+ 54	„	1,666	— 88	3·75	..
Weston-s-Mare ..	„ 22	44	+ 1	„	247	+ 88	3	..
‡Worcester	„ 22	472	+ 11	„	2,758	+ 73	5·75	..
Wrexham	„ 22	200	+ 22	„	1,096	+ 81	..	..
Yorks. Wool. Dist.	„ 22	2,013	+ 114	„	11,945	+ 464	17	..
Miscellaneous ..	„ 22	437	+ 68	„	2,374	+ 154	..	..
†Burnley	„ 23	1,882	+ 152	..	..	..	11·73	..
†Burton-on-Trent..	„ 24	257	+ 17	51	14,562	+ 781	6·6	..
†Bury..	„ 24	1,212	+ 144	51½	64,8.8	+ 5,008	23·5	..
†Cardiff	„ 23	7,952	— 154	51	128,525	+ 8,889	17·25	..
Chatham and Dist.	„ 21	1,531	+ 80	12	8,840	+ 48	14·95	..
†Cork	„ 21	487	+ 37	12	5,014	+ 47	9·38	..
Croydon	„ 15	3,347	+ 280	..	88,583	+ 5,8 8	11·6	·75
Darlington	„ 16	420	+ 25	51	11,295	+ 1,027	4·87	..
†Darwen	„ 22	229	+ 10	51	13,476	+ 883	4·25	..
Dover	„ 23	379	+ 42	51	12,570	+ 1,634	4·75	..
†Dublin	„ 22	5,561	+ 941	..	61,345	+ 3,188	54·25	..
†East Ham	„ 23	1,041	+ 39	51	56,327	+ 3,761	7·87	..
†Exeter	„ 22	268	— 1	51	12,945	+ 1,052	5·5	..
†Glasgow	„ 23	18,914	+1,809	..	719,096	+43,452	98	·25
†Hastings	„ 21	7·5	— 70	..	..	+ 201	19·3	..
†Huddersfield ..	„ 23	1,814	+ 99	51	97,438	+ 8,127	29·6	1
†Hull	„ 23	2,841	+ 98	51	150,488	+ 8,633	14·5	..
Ilkeston	„ 14	204	— 33	50	6,486	+ 114	3·3	..
†Ipswich	„ 23	3 5	+ 16	51	21,970	+ 1,188	10·5	..
Kilmarnock.. ..	„ 23	264	— 2	45	7,249	+ 467	4·25	..
Lancashire United	„ 27	2,188	— 198	..	14,864	— 54	89	..
†Leeds	„ 23	7 156	+ 368	51	883,936	+24,506	57·5	..
†Leicester	„ 23	2,418	+ 170	..	..	..	20	..
Leith	„ 23	1,346	+ 315	44⅝	23,805	+ 2,448	8·72	..
Liverpool	„ 23	22 884	—1,480	11½	186,348	+ 7,541	116	..
‡L.C.C.	„ 20	85,680	+3,118	..	2,224,216	+107,150	139·6	3
†London United ..	„ 23	5,452	+ 68	..	63,589	+ 1,056	..	..
†Lowestoft	„ 23	120	— 10	25	3,943	+ 15	3·5	..
†Manchester	„ 23	16,147	+ 939	51	829,992	+45,721	105	..
†Newcastle	„ 23	4,052	+ 271	..	218,850	+15,859	31·3	..
Newport	„ 23	1,115	— 103	51	35,696	+ 1,041	7·25	..
†Oldham	„ 24	1,945	+ 136	52	100,364	+ 5,221	23	..
†Pontypridd	„ 23	262	— 124	51	20,872	— 214	5·50	..
†Portsmouth	„ 23	1,601	— 11	51	108,290	+ 7,372	15·25	..
†Preston	„ 20	749	+ 84	51	39,553	+ 2,606	10	..
†Rotherham	„ 21	598	— 52	50½	34,941	+ 2,416	12	..
†Salford	„ 25	4,589	+ 220	51½	249,170	+10,498	41	..
†Sheffield	„ 26	6 024	— 99	..	336,871	+20,134	40	..
Southampton	„ 20	2.165	+ 239	51	62,172	+ 7,219	11	..
Southend-on-Sea ..	„ 27	1,080	+ 257	52	34,098	+ 5,464	7	..
†South Shields ..	„ 23	568	+ 2	51	31,584	+ 3,166	10·25	..
Swindon	..	..	..	..	..	..	..	..
†Tyneside	„ 20	453	+ 78	12	4,8:6	+ 253	11	..
Wallasey	„ 16	2,243	+ 377	50½	54,747	+ 6,719	8·72	..
†Walthamstow ..	„ 23	647	+ 25	51	37,495	+ 2,301	9	..
West Ham.. ..	„ 21	5 092	+ 272	51	187 998	+11,761	15·25	..
Wolverhampton ..	„ 27	1,880	+ 109	52	50,988	+ 2,885	13·75	..
†Cen. London Rly.	„ 23	4,905	— 400	12	60,538	— 4,150	6·32	..
†City & S. Lon. Rly.	„ 24	3,248	— 180	12	30,497	— 1,142	7·26	..
†Dublin-Lucan Rly.	„ 22	188	+ 89	12	1,296	+ 40	7	..
†G.N. and City Rly.	„ 23	1,616	+ 74	12	20,434	+ 1,279	3·5	..
†L'pool Overh'd Rly.	„ 24	1,424	+ 60	12	17,684	+ 1,215	6·6	..
†Llandudno-Col. Bay	„ 22	155	+ 23	16½	2,212	+ 212	6·5	..
†Lond. Elec. Ry. Co.	„ 23	14,245	+ 250	12	177,640	+ 7,365	21·25	..
†Mersey Railway ..	„ 23	1,906	— 119	12	24,616	+ 245	4·5	..
†Metropolitan Rly.	„ 24	14,662	—1,671	12	200,894	— 1,837	25·75	..
†Met. District Rly.	„ 23	12,275	+ 290	12	151,886	+ 7,429	25	..
Anglo-Argentine ..	„ 25	102,557	+1,571	..	616,495	+22 145	..	..
§Auckland	Mar.	17 4·3	+1,409	..	154,172	+12,457	38·3	..
Bombay (B.E.T.) ..	Mar. 16	6,873	+ 452	7	20,563	+ 1,778	..	..
§Brisbane	Feb.	6,700	—1,976	8	23,734	—1s,101	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
†Calcutta	Mar. 25	3,905	+ 405	..	..	..	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A...	Feb.	2,684	..	8	5,568	..	20·5	..
§Lisbon	..	..	..	..	..	..	..	..
Madras	Mar. 15	1,584	— 141	10	7,788	+ 190	..	..
§Montevideo ..	Feb.	35 021	+5,223	4	125,883	+18,357	..	..
†Perth (W.A.) ..	Mar. 22	1,906	+ 278	..	22,624	+ 3,345	29	..

* Compared with the corresponding period of 1911. † One week only.
‡ Includes horse, steam and other receipts. § One month.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations March 30th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord. ..	10	5½	5½	8¼ — 9¼ xd	..	5 19 0
Do. 4½ % Pref.	10	4½	4½	8½ — 9½	..	4 14 9
Do. Second 6 % Pref. ..	10	6	6	10½ — 11	..	5 9 1
Do. 4½ % Deb. Stock	Stock	4½	4½	100 —102	..	4 8 3
Brompton & Kensington, Ord...	5	10	10†	8¼ — 8⅝ xd	..	5 14 3
Do. 7 % Cum. Pref.	5	7	7	7⅝ — 7¾ xd	..	4 6 2
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101	..	3 19 3
Charing Cross, West End & City	5	5	5	4⅜ — 4⅝	+ ⅛	5 2 7
Do. 4½ % Cum. Pref.	5	4½	4½	4½ — 4⅝	..	5 0 0
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	8⅝ — 4⅝	..	5 2 10
Do. Do. 4 % Deb... ..	100	4	4	94 — 97	+1	4 2 6
Chelsea, Ord.	5	5	5	4¾ — 5	..	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	98 —101	..	4 9 1
City of London, Ord.	10	7	8	18½ — 20	..	4 0 0
Do. 6 % Cum. Pref.	10	6	6	13½ — 15½	— ½	3 17 5
Do. 5 % Deb.	Stock	5	5	117 —121	..	4 2 8
Do. 4½ % Second Deb. ..	100	4½	4½	101 —104	..	4 6 7
County of Durham, 5 % First Mort. Deb.	Stock	5	5	87 — 89	..	5 12 4
County of London, Ord... ..	10	5	6	10¾ — 11	— ⅜	5 9 1
Do. 6 % Pref.	10	6	6	11⅛ — 11⅜	..	5 3 0
Do. 4½ % Deb.	Stock	4½	4½	107 —109	..	4 2 7
Do. 4½ % Second Deb. ..	Stock	4½	4½	101 —104	..	4 6 7
Edmundson's, Ord.	5	Nil	Nil	⅜ — ½	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2¾ — 3⅜	..	Nil
Do. 4½ % First Mort. Deb. ..	100	4½	4½	86 — 89	..	5 1 2
Folkestone	5	6	6†	4½ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4⅝ — 5⅛	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	93 — 96	..	4 13 9
Hove	5	9	9	6¾ — 7½	..	6 4 2
Kensington & Knightsbridge, Ord	5	9	9	6¾ — 7½	..	6 4 2
Do. 4 % Deb.	Stock	4	4	92 — 95	..	4 4 3
Kent Elec. Power, 4½ % Deb. ..	Stock	4½	4½	80 — 84	..	5 7 2
London Electric, Ord.	8	2	2½	1¾ — 2¼	+ ⅛	2 19 8
Do. 6 % Pref.	5	6	6	4¾ — 5¼	..	5 14 3
Do. 4 % First Mort. Deb. ..	Stock	4	4	90 — 93	..	4 6 0
Metropolitan	5	5	4†	3⅝ — 4⅛	— ⅛	6 1 3
Do. 4½ % Cum. Pref.	5	4½	4½	4¼ — 4⅜	..	4 17 4
Do. 4½ % First Mort. Deb. ..	Stock	4½	4½	99 —104	..	4 6 7
Do. 3¾ % Mort. Deb.	Stock	3¾	3¾	84 — 87	..	4 0 6
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96 — 98	..	4 11 10
Newcastle-on-Tyne	5	4	4†	3⅞ — 3⅞ xd	..	5 3 3
Do. 5 % Pref., Non-Cum. ..	5	5	5	3¼ — 4⅛ xd	..	5 14 3
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	99 —102	..	4 13 0
Notting Hill, 6 % Non-Cum. Pref.	10	..	..	10 — 11	..	5 9 1
Oxford	5	7½	7½	5⅞ — 6⅜	..	5 13 9
St. James' and Pall Mall, Ord.	5	10	10	8½ — 9	+ ⅛	5 11 1
Do. 7 % Pref.	5	7	7	6¾ — 7¼	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	85 — 87	..	4 0 6
Smithfield Markets, Ord. ..	5	Nil	2	1⅜ — 1⅝	..	..
South London, Ord.	4	5	5	2⅝ — 3½ xd	— ⅛	6 8 0
Do. 5 % First Mort. Deb. ..	100	5	5	99 —102	..	4 18 0
South Metropolitan, 7 % Pref...	1	7	7	1 — 1¼	..	6 4 5
Do. 4½ % First Deb. Stock ..	100	4½	4½	95 — 98 xd	..	4 11 10
Urban, Ord...	5	5	..	¾ — ⅞	..	..
Do. 5 % Cum. Pref.	5	5	..	2⅜ — 3¼	..	..
Do. 4½ % First Mort. Deb. ..	100	4½	4½	85 — 87 xd	..	5 3 6
Westminster, Ord.	5	10	10	8½ — 9¼	..	5 8 1
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5¼	..	4 5 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅝ — 5⅞	..	5 2 2
Calcutta, Ord.	5	8½	7†	6¾ — 7¼	+ ⅛	5 17 3
Do. 5 % Pref.	5	5	5	5 — 5¼	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	92½ — 94½	..	5 5 8
Canadian Gen. El. Com. ..	$100	7	7†	113 —117 xd	..	5 19 8
Do. 7 % Pref.	$100	7	7	114 —118 xd	..	5 18 8
Cordoba Lt., Power and T., Ord.	1	3	3†	3⅜ — 1⅝	..	2 18 3
Do. 5 % Deb.	100	5	..	93 — 98 xd	..	5 2 0
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	92 — 94	..	6 7 8
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	83 — 86	..	5 16 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	92½ — 94½	..	5 5 10
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	7/16 — 5/16	..	Nil
Do. 6 % Pref.	1	6	6	⅜ — ½	..	8 0 0
Kaministiquia Power, 5 % G. Bs.	$500	5	5	110 —112	+2	4 9 3
Madras, Ord.	5	..	..	2½ — 3	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	102 —105	..	4 15 3
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	84½ — 86½	..	5 15 7
Mexican Lt. & Power, Common	$100	4	4†	85 — 87	..	4 12 0
Do. 7 % Cum. Pref.	$100	7	7	105 —107	..	6 10 10
Do. 5 % 1st Mort. Gold Bds.	..	5	5	94½ — 96½	..	5 3 8
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	88 — 90	..	5 11 1
Montreal, Lt., H. and Power ..	$100	7	8	198 —202	..	3 19 3
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	..	39 — 41	..	12 3 10
River Plate, Ord.	Stock	10	..	248 —258	..	3 17 6
Do. 6 % Non-Cum. Pref. ..	Do.	6	6	110 —115	..	5 4 4
Do. 5 % Deb. Stock	Do.	5	5	102½—104½	..	4 15 8
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	101 —103	..	4 7 5
Shawinigan Water, Capital ..	$100	4	5†	137 —140	+4½	3 11 5
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	108 —110	..	4 11 0
Do. 4½ % Per. Deb.	Stock	4½	4½	103½—105½	..	4 5 4
Toronto Power, 4½ % Deb. ..	Do.	4½	4½	99½—101½	..	4 8 8
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92½ — 94½	..	5 5 10
Victoria Falls Power, Pref. ..	1	Nil	11¼d.	7/16 — 15/16	— 3/32	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	104½ —106½	..	5 12 8

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	4†	7⅛ — 7⅞	..	..
Do. 5 % Deb. Red.	Stock	5	5	97½ — 99½	..	5 0 6
American Telep. & Teleg., Cap.	$100	8	8†	149½ —151½ xd	..	5 5 7
Do. Collat. Trust	$1000	4	4	94 — 96	..	4 3 4
Anglo-American Telegraph ..	Stock	8⅜	8	66 — 68	..	4 8 6
Do. 6 % Pref.	Do.	6	6	110 —111	..	5 8 1
Do. Def.	Do.	30/-	30/-	24⅞ — 25⅞	— ⅛	5 18 2
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	100 —102	..	4 18 0
Chili Telephone	5	7	..	7⅛ — 7½	..	4 13 4
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	85¼ — 87¾ xd	..	4 11 5
Cuba Telegraph	10	6	6†	9¾ — 10¾	..	5 11 7
Do. 10 % Pref.	10	10	10	17 — 18	..	5 11 1
Direct Spanish Telegraph, Ord.	5	4	4†	8¼ — 8⅞ xd	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	7⅞ — 8¼ xd	..	6 1 3
Do. 4½ % Debs.	50	4½	4½	99 —101	..	4 9 1
Direct United States Cable ..	10	4½	..	7½ — 8	..	5 12 6
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	99 —101	..	4 9 1
Eastern Telegraph, Ord. Stock	Stock	7	5†	129 —133	..	5 5 3
Do. 8½ % Pref. Stock.. ..	Do.	8½	8½	80 — 82	..	4 5 4
Do. 4 % Mort. Deb.	Do.	4	4	100½—102½	..	3 18 1
Eastern Extension	10	7	5†	12¼ — 12⅝	..	5 9 10
Do. 4 % Deb.	Stock	4	4	9⅝ —101⅝	..	3 18 10
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	99 —101	..	3 19 3
Globe Telegraph and Trust ..	10	5⅞	6†	10½ — 11 xd	+2/-	5 9 1
Do. 6 % Pref.	10	6	6	12¼ — 13⅜ xd	+3/-	4 9 9
Great Northern Telegraph ..	10	18	5†	31¼ — 33½	+ ¼	5 8 3
Indo-European Telegraph ..	25	13	5†	56½ — 58½	..	5 10 2
Mackay Companies Common ..	$100	5	5†	81 — 84 xd	..	5 19 1
Do. 4 % Cum. Pref.	$100	4	4	70 — 73 xd	..	5 9 7
Marconi's Wireless Telegraph	1	5	..	6 11/16 — 6 13/16	+ 1/16	..
Do. 7 % Cum. Partic. Pref.	1	16	..	5 15/16 — 6 1/16	+ 1/16	..
Monte Video Telephone, Ord...	1	6	6	1 — 1⅛	..	5 6 2
Do. 5 % Pref.	1	5	5	⅜ — ⅝	..	5 10 6
National Telephone, Pref. ..	Stock	6	6†	99½ —102½	..	5 17 1
Do. Def.	Do.	6	6†	133 —135	+4½	4 8 11
Do. 6 % Cum. 2nd Pref. ..	10	6	6	9¼ — 10	..	6 0 0
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5¼ — 5⅝	..	4 15 3
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	102¾—103¾	..	4 6 9
Oriental Telep. and Elec. ..	1	8	..	1⅜ — 1½	..	4 11 5
Do. 6 % Cum. Pref.	1	6	6	1⅜ — 1½	..	4 16 10
Do. 4 % Red. Deb.	Stock	4	4	87½ — 89½	..	4 9 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98¾—100½	..	3 19 7
Reuter's	8	8	5†	12 — 13½	..	3 5 4
Submarine Cables Trust ..	Cert.	6	6	130 —133	..	4 10 3
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99 —101	..	4 9 1
United River Plate Telephone	5	8	8	7½ — 7⅞	..	5 8 3
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 8 11
West Coast of America	2½	2½	2½	1⅝ — 1¾	..	3 11 5
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	97½ — 99½	..	4 0 5
West India and Panama Teleg.	10	1½	1½†	4 7/16 — 4 13/16	+ 1/16	..
Do. 6 % Cum. 1st Pref. ..	10	6	6	10⅝ — 11½	..	5 6 8
Do. 6 % Cum. 2nd Pref. ..	10	6	6	9½ — 10½	— ⅛	5 17 1
Do. 5 % Debs.	100	5	5	102 —104	..	4 16 2
Western Telegraph, Ltd. ..	10	7	6†	13 — 13½ xd	..	5 3 8
Do. 4 % Deb.	Stock	4	4	99 —101	..	3 19 3
Western Union Tel., 4% Bnds. A	$1000	4	4	106 —109	..	3 13 5
Do. 4½ % Fdg. Bonds.. ..	$1000	4½	4½	102 —105	..	4 5 9

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations March 30th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	7/8 — 15/16	..	Nil
Do. 5 % Pref.	1	5	5	3/8 — 1/2	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	78 — 83 xd	..	5 8 5
Brit. Elec. Trac., 6 % Pref.	100	..	..	12 — 14	..	..
Do. Do. Deferred	100	..	..	8 — 10	..	..
Do. Do. 6 % Cum. Pr'f.	100	..	..	90½ — 92½	..	..
Do. 7 % Non-Cum. Pr'f.	100	..	..	36 — 39	..	..
Do. 5 % Perp. Deb.	100	5	5	93½ — 96½	—2½	5 3 8
Do. 4½ % 2nd Deb.	100	4½	4½	80 — 84	..	5 7 2
Central London Railway, Ord.	100	8	8	86 — 88	..	3 8 2
Do. Pref.	100	4	4	86 — 88	..	4 10 11
Do. Def.	100	2	2	86 — 88	..	2 5 5
Do. 4 % Deb.	100	4	4	101 —103	..	3 17 8
City & South London, Ord.	100	1½	1½	42½ — 43½	+ ½	3 14 9
Do. 5 % Pref., 1891	100	5	5	107 —109	..	4 11 9
Do. Do. 1896	100	5	5	102 —104	..	4 16 2
Do. Do. 1901	100	5	5	101 —103	..	4 17 1
Do. Do. 1908	100	5	5	101 —103	..	4 17 1
Do. 4 % Deb.	100	4	4	101 —103	..	3 17 8
Dublin United Trams, 6 % Pref.	10	6	6	10⅞ — 11⅜	..	5 2 2
Great Northern & City, Pr'f. Ord	10	Nil	..	2⅜ — 2⅝	+ ⅛	Nil
Hastings Trams, 6 % Pref.	5	Nil	8†	3/16 — 5/16	..	..
Do. 4½ % Deb.	100	4½	4½	71 — 76 xd	..	5 18 5
Isle of Thanet Trams, 5 % Pref.	5	2½	2½	2⅜ — 2¼	..	4 6 11
Do. 4 % Deb.	100	4	4	75 — 80	..	5 0 0
Lancashire United, 5 % Deb.	100	5	5	82 — 84	..	5 19 1
London Elec. Railw'ys, 4 % Deb.	100	4	4	97 — 99	..	4 0 10
London United Trams, 5 % Pref.	10	Nil	..	3¾ — 4	..	..
Do. 4 % Deb.	100	4	4	75 — 78	..	5 2 7

NAME.	Stock or Share.	Dividends for 1910.	Dividends for 1911.	Closing Quotations March 30th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Metropolitan Railway Consol.	100	1⅜	1⅜	63½ — 64	+3	2 18 7
Do. Surplus Lands	100	2½	2½	67 — 69	..	4 3 4
Do. 3½ % Deb.	100	3½	3½	89 — 91	..	3 16 11
Do. 3½ % Pref.	100	3½	3½	85 — 87	..	4 0 6
Do. 3½ % Con. Pref.	100	3½	3½	84 — 86	..	4 1 5
Metropolitan District Ord.	100	Nil	..	42⅜ — 43½	+4½	Nil
Do. 6 % Deb.	100	6	6	144 —146	..	4 2 2
Do. 4 % Deb.	100	4	4	96 — 98	..	4 1 8
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	3½	4½	89 — 91	..	4 18 11
Do. 3½ % Gtd.	100	3½	3½	76 — 78	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	5⅝	5†	33/32 — 1 1/32	+ 1/16	5 6 8
Do. Def.	1	Nil	..	3/32 — 5/32	..	Nil
Do. 5 % Pref.	1	5	5	3/32 — 5/32	..	5 14 3
Do. 4½ % Deb.	100	4½	4½	99 —101	..	4 9 1
Do. 5 % Deb.	100	5	5	98 —100 xd	..	5 0 0
Potteries, Ord.	1	2	..	13/32 — 17/32	..	..
Do. 5 % Pref.	1	5	5	29/32 — 31/32	..	6 19 8
Do. 4½ % Deb.	100	4½	4½	89 — 92	..	4 17 10
South Metro. Trams, 6 % Pref.	1	6	..	3/4 — 7/8	..	6 17 2
Do. 4 % Deb.	100	4	4	72 — 77	..	5 4 0
Underground Elec. Railways	10	..	..	3¾ — 4	+ ⅜	..
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 1
Do. 6 % Income	100	1	1½†	88 — 90	..	..
Yorkshire (West Riding), Ord.	5	Nil	..	1/4 — 3/8	..	Nil
Do. 6 % Pref.	5	Nil	..	2¼ — 3½	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 84	..	5 7 2

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5½	5⅛ — 5⅜	+ 1/16	5 2 4
Do. 2nd Pref.	5	5	5½	4 15/16 — 5 1/16	..	5 3 6
Do. 4 % Deb.	100	4	4	93½ — 95	..	4 4 3
Do. 4½ % Deb.	100	4½	4½	102 —104	..	4 6 7
Do. 5 % Deb.	100	5	5	103 —105	..	4 15 3
Auckland Trams, 5 % Deb.	100	5	5	102 —105	..	4 15 3
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅜ — 11½	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	98 —100	..	4 10 0
Do. 5 % 2nd Deb.	100	5	5	98 —100	..	5 0 0
Brisbane Trams Invt., Ord.	5	8	8†	8⅜ — 9⅛	+ 1/8	4 6 6
Do. 6 % Pref.	5	6	6	4⅝ — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	100 —103	..	4 7 5
B. Columbia Elec. Rly., Def.	100	8	8†	138 —143	+3	5 11 11
Do. Pref. Ord.	100	6	6	122½ —126½	+1½	4 14 10
Do. 6 % Pref.	100	6	6	111½ —114½	+1½	4 7 4
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	103 —105	..	4 5 9
Do. 4½ % Con. Deb.	100	4½	4½	102 —104	..	4 6 7
Calcutta Trams, Ord.	5	6	..	6 — 6¼	..	4 16 0
Do. 6 % Pref.	5	5	5	4 15/16 — 5 1/16	..	4 16 5
Do. 4½ % Deb.	100	4½	4½	99 —102	..	4 8 3
Cape Electric Trams	1	Nil	2½†	2⅜ — 2½	..	..
City Buenos Aires Trams (1904)	5	5	5	5 1/16 — 5 1/8	..	4 6 0
Do. 4 % Deb.	100	5	5	101 — 103	..	4 17 3
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	93 — 98	..	5 2 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	100 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	..	3/32 — 5/32	..	Nil
Do. 5 % A Deb.	100	5	5	91 — 94	..	5 6 5
Do. 6 % B Deb.	100	5	6†	£6 — 60	..	10 0 0

La Plata Elec. Trms, Ord.	1	..	..	3/8 — 3/4	..	..
Do. Pref.	1	6	6	1 — 1 1/8	..	6 0 0
Lisbon Elec. Trams, Ord.	1	5½	6†	1 — 1½	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1¼	..	4 16 0
Do. 5 % Deb.	100	5	5	95 — 99	..	5 1 0
Madras Elec. Tr. (1904), Deb.	100	5	5	96½ — 98½	..	5 1 6
Manaos Trams & Lt., 1st Deb.	100	5	5	93 — 96	..	5 4 2
Manila Elec. R. and Ltg., Bonds	$1000	5	5	99½ —101½	..	4 18 6
Mexico Trams Com.	$100	7	7†	119 —121	..	5 15 8
Do. Gen. Con. 5 % Bonds	..	5	5	96½ — 98½	..	5 1 6
Do. 6 % Bonds	100	6	6	100½ —102½	..	5 17 1
Para Elec. Rlys. & Lt., Ord.	5	10	10	6⅞ — 7⅛	..	7 0 4
Do. 6 % Pref.	5	6	6	5 — 5⅛	..	7 0 4
Do. 5 % 1st Deb.	100	5	5	97½ — 99½	..	5 0 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	1 1/16 — 1 1/8	..	1 18 1
Do. 5 % 1st. Deb.	100	5	5	101 —104	..	4 16 2
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅜ — 5⅝	+ ⅛	5 6 8
Do. 4½ % 1st Deb.	100	4½	4½	98 —101	..	4 9 1
Rio de Janeiro Trams	$100	4½	5†	119 —120	+ ½	4 3 4
Do. 1st Mort. 5 % Bonds	..	5	5	103 —104	..	4 16 2
Do. 5 % Mort. Bonds	100	5	5	99½ —100½	..	4 19 9
Sao Paulo Tram, Lt. and P.	$100	10	10†	197½ —199½	..	5 0 3
Do. 5 % 1st Deb.	$500	5	5	104 —106	..	4 14 4
Singapore Trams, 5 % Deb.	100	5	5	81 — 84	..	5 19 1
Southern El. Tr. B.A., 5 % Deb.	100	5	5	93 — 95	..	5 5 3
Un. Elec. Trams Monte Video	5	6	7	5½ — 5⅝	..	6 1 9
Do. 6 % Pref.	5	6	6	5⅜ — 5⅝	..	5 11 7
Do. 5 % 1st Deb.	100	5	5	101 —104	..	4 16 2
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	103 —105	..	4 5 9

MANUFACTURING COMPANIES.

Aron, Ord.	1	Nil	6	5/8 — 3/4	..	..
Do. 6 % Pref.	1	9	6	29/32 — 31/32	..	7 2 2
Babcock & Wilcox	1	26	24†	6⅝ — 6¾	+ 1/8	3 15 7
Do. Pref.	1	6	6	1⅜ — 1⅝	..	3 13 10
B.I. & Helsby Cables	5	10	10	6¾ — 7 xd	..	7 2 10
Do. Pref.	5	6	6	5⅞ — 6⅛	..	4 16 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
British Thomson-Houston, Deb.	100	4½	4½	92 — 95	..	4 13 9
British Westinghouse, Pref.	3	Nil	..	3/4 — 1	+ 1/8	Nil
Do. Deb.	100	4	4	60 — 64	+1	6 5 0
Do. 6 % Prior Lien	100	6	6	102 —105	..	5 14 8
Browett, Lindley, Ord.	1	Nil	..	1/6—2/-	..	Nil
Do. Pref.	1	Nil	..	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	..	0 — 1/4	..	Nil
Do. 7 % Pref.	2	Nil	..	0 — 1/4	..	Nil
Do. 4½ % Deb.	100	4½	4½	54 — 59	..	7 10 6
Do. 4½ % Second Deb.	100	4½	4½	37 — 42	..	10 14 4
Callender's Cable	5	15	10†	9½ — 10½	— ½	7 6 4
Do. Pref.	5	5	5	5 — 5½	..	4 15 3
Do. Deb.	100	4½	4½	98 —100	..	4 10 0
Castner-Kellner	1	17½	20	3½ — 3⅝	..	5 10 4
Do. Deb.	100	4½	4½	105 —109	..	4 10 7
Crompton & Co.	3	Nil	Nil	1/8 — 3/8	..	Nil
Do. Deb.	100	5	5	58 — 68	..	7 7 1

Dick, Kerr	1	5	..	3⅞ — 4	..	5 8 1
Do. Pref.	1	6	6	1 1/16 — 1 1/8 xd	..	5 12 11
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Edison & Swan, A, £3 paid	5	Nil	..	1/4 — 5/16	..	Nil
Do. fully paid	5	Nil	..	1/2 — 2⅜	..	Nil
Do. 4 % Deb.	100	4	4	71 — 75	..	5 6 8
Do. 5 % Second Deb.	100	5	5	75 — 78 xd	..	6 8 2
Electric Construction	2	Nil	2½†	3/4 — 1	..	..
Do. Pref.	2	7	7	1⅝ — 1⅞	..	7 9 4
Greenwood & Batley, Pref.	10	7	7	7⅞ — 8½	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	9 — 9½	..	5 5 3
Do. Deb.	100	4	4	85 — 90	—2	4 8 11
Henley's, Ord.	5	15	10†	11½ — 12½	..	6 2 6
Do. Pref.	5	4½	4½	4 1/16 — 5 1/16	..	4 6 9
Do. Deb.	100	4½	4½	104 —106	..	4 4 11
India-Rubber, G. & T.	10	10	..	9⅜ — 10⅜	..	..
Do. Pref.	10	5	5	9½ — 10½	..	4 17
Telegraph Construction	12	20	10†	33 — 35	..	6 15 2
Do. Deb.	100	4	4	99½ —101½	..	4 9 0
Willans & Robinson	1	Nil	..	1/8 — 1/4	..	Nil
Do. Pref.	5	Nil	..	1/2 — 1¼	..	Nil
Do. Deb.	100	4	4	59 — 61	—2½	6 11

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

The yields are calculated in most cases upon the dividends paid for 1910.

Bank rate of Discount 3½ per cent., February 8th, 1912.

REVIEWS.

Rubber. By Philip Schidrowitz, Ph.D., F.C.S. 1911. London: Methuen & Co. Price 10s. 6d. net.

The author of this work is a well-known authority on rubber, and has aimed at presenting in a practical manner the most important features of the rubber industry to the layman, as well as to the technical man. The book contains numerous reproductions of photographs taken by the author himself during a recent tour in Malaya and Sarawak, together with others from Africa and South America, most of which are deserving of the highest commendation. Praise must also be accorded to the illustrations of machines, as well as to the production of the book as a whole. After a chapter on the history of the industry, Dr. Schidrowitz discusses the production and consumption of rubber in the leading countries of the world; he estimates that in 1915-16 the plantations should produce over 80,000 tons of rubber, out of a total of about 150,000 tons. This country consumes about ⅛ of the world's total.

He then treats of the conditions and methods of rubber production obtaining in South America, and passes on to the Eastern plantations, the foundation of which he regards as the most important occurrence in the rubber industry since the invention of the process of vulcanisation. It is estimated that the total acreage under planted rubber is nearly a million acres, which in time will probably yield 300 or 400 lb. per acre per annum.

The planting, care, and tapping of rubber trees are dealt with in an interesting and instructive way, followed by a discussion of the mechanical treatment of the product before it leaves the country of origin. The subject of rubber latices and their coagulation is one to which the author has obviously devoted much attention, and, together with the chemistry of rubber and the theory of vulcanisation, is treated at considerable length.

The remainder of the work deals with the manufacture of rubber goods, many of the processes being extremely interesting, and the various properties of vulcanised rubber and the chemical, physical and mechanical tests to which it can be put. The work of Prof. Schwartz in this connection receives due notice.

At the end of the book extracts from a paper by the author on the main causes of difficulties between manufacturers and consumers are reprinted. The work can safely be commended to all who are interested in this important subject, though the author does not deal with the use of rubber in the electrical industry.

Machine Tools. By J. W. French, B.Sc. Two volumes. London: The Gresham Publishing Co., Ltd. Price 42s. net.

These two large volumes contain a great deal of useful and interesting information. The outstanding feature is the method by means of which the arrangements of the parts of the details of some typical tools are illustrated. This is done with a series of sectional models. Thus, in the case of a lathe there are two pieces of thick paper pasted on to the plates, to represent the headstock. The reader turns back the top piece, and sees within the two half sections of the headstock; he then looks on the back of the second piece of paper, and sees the other elevations of the headstock. This idea is ingeniously carried out in order to exhibit the sections of the framing of the tools, the gearing and other internal parts. There is a key to each of the illustrations.

Another interesting feature of the book is the fore-word by Prof. J. D. Cormack, of University College, London. He says:—"Fifty years ago the machine shop of an engineer contained a comparatively limited number of types of machine tools. Machines of the same type were distinguished chiefly by size, and one important aim of the designer was to produce tools which could deal with a large variety of work, for at that time a typical engineer's shop had very varied work in hand, and the same tool was called upon to deal with a succession of jobs whose character was continually changing. Little was written in regard to these tools, and a knowledge of the uses and possibilities of a tool was acquired in a somewhat haphazard fashion by the young engineer in the course of his apprenticeship. The tools of that time, however, turned out good work, and some of them of good design and workmanship are still in use."

He then goes on to show how during the last 25 years there has been enormous progress in new and improved kinds of tools. At the same time, it is only those mechanical engineers who are specially concerned with either the product or the use of such tools that take much interest in them.

Until recently there has been very little literature on the subject. Mr. French has produced a book that Prof. Cormack calls "readable, interesting and useful." So far as we can gather, he has collected together a great deal of information from the leading tool-making firms concerning their products, and has made every use of their catalogue illustrations. We are not quite sure for what class of reader the work has been produced.

Although the two volumes are beautifully got up, yet we cannot help feeling that 42s. is a large sum to spend in the purchase of them. For instance, we should not like to recommend an ambitious mechanic to expend that amount, and it is more than the ordinary engineering student can afford.

A very large number of the illustrations are from the makers' catalogues, and a good deal of the letterpress must have been obtained from the same source. Of course, it may be argued that the descriptions of the various tools have been condensed, and that the various makes of the same class of tools are easily compared. On the whole, however, we cannot help feeling that the most generous subscribers should be the firms whose names appear in such large letters on the illustrations.

We wish to give the author full credit for his ingenious models and energy for collecting together information, all of which seems to be right up to date. We must, however, judge of the book by the standard of whether it is good value for the money expended.

We think that the whole thing has been produced in too lavish a fashion; the art paper, the large size pages, with the big margin, the somewhat grandiose binding; all that sort of thing has to be paid for. If the author had been contented with his models, some sectional illustrations, and a rather more close editing of the text, he could surely have produced a book which would have fitted on an ordinary shelf of the library, and it would have been obtainable at, say, a half, or even a quarter, of the price of the volumes before us. It is only fair to add that we can trace no errors in the text, and we think the style of description good.

Alternating Current Design. By Julius Frith. 1912. London: Harper & Brothers. Price 5s. net.

This book is intended to be a companion volume to the treatise on "Continuous Current Machine Design" issued by the same publishers, and the reader is referred to this work for the information common to both classes of design, in order to save duplication.

Chapter I deals with the elementary properties of alternating currents. Presumably everyone commencing to read a book on design has some previous knowledge at least of the principles of the subject, and the reason for introducing a chapter of this kind is not clear.

Armature reaction is treated by means of vector diagrams in the second chapter. A small amount of information is also given regarding the regulation of alternators.

The third chapter, consisting of three pages, is devoted to the consideration of the relations between core dimensions and output. We are of the opinion that the chapter would have been considerably improved if quadrant diagrams had been given for gap induction, ampere-conductors per inch of circumference, number of poles, &c. The values given for these vital points in the design of an alternator are somewhat vague and meagre.

The design of a 250-kw. alternator is worked out in detail in Chapter IV. The treatment is evidently based on practical experience in the design of alternators, and the chapter is a distinct improvement on the preceding ones.

The next two chapters are short articles dealing with the parallel running of synchronous machinery, and the compounding of alternators, respectively. The matter is put

forward in an interesting style and the chapters are quite good as far as they go.

Chapter VII deals with the theory of induction motors and the method of calculating the leakage coefficient; the Heyland diagram, and so on are well treated.

The design of a 50-H.P. induction motor is next worked through, and like the design of the alternator, bears the stamp of the practical man rather than that of the theorist.

The design of static transformers is dealt with in Chapter IX and an example is worked out in Chapter X. The treatment is really not at all bad, but we are sceptical as to how far a student would get in the design of a commercial transformer after having read these chapters.

Very short chapters are then devoted to transmission lines and choking coils, together with two more worked examples dealing with the design of an alternator and a two phase squirrel cage induction motor and auto-starter.

A two-page appendix gives some information which is really not worth putting in a book of this character.

The book consists of only 115 pages of large print and we are of the opinion that the author has attempted to cover far too wide a ground in the space at his disposal. The author's style is good and interesting, and it is a pity that he did not confine his attention to, say, the design of alternators and induction motors. Surely there is a limit to the number of subjects which even a modern student requires in a book which is sold at 5s. net.—H.G.S.

Boiler Draught. By H. K. Pratt. London: Constable and Co., Ltd. Price 4s. net.

This little book may be found useful to some engineers, although it appears to us to be rather superfluous. It contains a good deal of matter that is found in most of the books on boilers. We cannot imagine any man sufficiently intelligent to read this book who has not one of the standard treatises on boilers, in which may be found practically everything that it contains.

There are eleven chapters in all, the first of which occupies about a page and a half, and contains about 500 words of an introductory nature. The next chapter is on calculations relating to air, and the third is on chimneys.

An example is given of the way in which the height of a chimney necessary to burn fuel at a definite rate is calculated, but there seems nothing original in the methods used.

The best pages are those on artificial, forced and induced draught, but here the illustrations are not very good and not sufficiently numerous.

As for the last chapter on the chemistry of combustion, well, you can get all that, and a great deal more, in a handy little book on heat engines published at about 2s. 6d. On the whole, we reluctantly come to the conclusion that most of the contents are to be found in an ordinary engineer's pocket-book, and there seems to be no *raison d'etre* for this latest addition to the literature about boilers. We can find no actual mistakes in the text or calculations, so the contents may be taken as reliable.

An Electrical Invention (?).—Reports have appeared in the lay Press regarding a phenomenal invention put forward in New York by an "electrical engineer," who is said to have been working on the thing for 18 years. He made the well-known discovery that an alternating magnetic field (called a "current" in the report) repels metals, and proposes to utilise this principle to abolish gravitation in the case of railway trains, by building a row of electromagnets along the track, which repel the aluminium base-plate of a steel car, and thus cause the car to "float." Other electromagnets pull the car to and fro. The idea appears to be that cars will "slide through the air at a speed of 300 miles an hour without encountering any friction except air resistance." We do not know how far the report may be trusted; but if there is a grain of truth in it—and the account is circumstantial enough—we can only regret that an intelligent man should so utterly waste his time as to pursue an investigation of this kind. Had he taken the trouble to study his subject, he would have found that friction can easily be made an almost negligible matter, and his method does not reduce in the least the energy that must inevitably be expended in overcoming gradients; moreover, at 60 miles an hour air resistance is by far the most important factor, and as it increases as the square of the velocity, a speed of 300 miles an hour could not possibly be approached by a self-propelled car. The scheme is hopelessly impracticable, and in addition is uncalled for. Nobody wants to travel at such high speeds.

ELECTRICAL LAW IN THE BRITISH DOMINIONS.

[FROM OUR LEGAL CONTRIBUTOR.]

(*Continued from page* 498.)

16. *Orange River Colony.*—By an ordinance (No. 27 of 1905) "for regulating the employment of electricity for the purposes of electric lighting and powers generally," it is provided that the Lieutenant-Governor may make regulations similar to that of the English Board of Trade for securing the safety of the public and for minimising as far as may be reasonable any interference with the electric lines of the Government, or of any other authority, company or person, and may provide for penalties. The regulations must deal (*inter alia*) with the height, dimensions, &c., of poles and their connections with earth; the height of wires above the earth; the precautions to be observed to prevent the fall of wires; the employment of insulated returns; and prevention of electrolytic action, and generally the use of overhead wires for currents of high or low pressure.

17. *Natal.*—There does not seem to be any public Act in force in Natal which authorises or regulates the supply of electricity. In 1902, however, an Act was passed entitled the "Durban County Tramways, Lighting, and Electric Current Supply Act." The greater part of this Act, of course, relates to the establishment of an electric tramway, and is, therefore, somewhat outside the scope of this article, but reference may be made to other provisions which show the trend of legislation in the colony anent the supply of electricity for light and power.

By Sec. 4 the promoters are "authorised and empowered, subject to such terms as may be imposed by the Government in the contract referred to in Sec. 5 hereof (*vide infra*) to construct, carry on, complete and maintain the said tramways, and to erect standards, posts, supports or other requisite appliances, whether above or below the surface of the ground, for wires or cables, for transmitting electric current for the purpose of the said tramway, or for the purpose of supplying the same for electric lighting and other purposes to the owners or occupiers of lands adjacent to or near to the said tramway, and to transmit and supply the same for the purpose aforesaid and elsewhere in the County of Durban according to the rules, orders and directions hereinafter set forth and expressed for that purpose."

By Sec. 5 "The promoters and the Government of Natal are hereby authorised to contract with each other for the purpose of the promoters acquiring from the Government aforesaid, whether by way of letting, hiring, or granting, and upon such terms as may be mutually agreed upon, the following rights:—

"(*a*) The right of constructing the said tramway aforesaid along the hereinafter mentioned public roads, and the right of working the same.

"(*b*) The right of erecting, or constructing and working, standards, posts, supports, or other adequate appliances, whether above or below the surface of the ground, for wires or cables on and along the hereinafter mentioned public roads, for the purpose of transmitting or carrying electric current, together with the right of working or transmitting along such wires or cables electric current for lighting or other purposes."

It is provided by Sec. 17 that "subject to the acquisition of powers from the said Government in terms of the Act, the promoters shall have the right to contract with the owners or occupiers of land in the County of Durban for the supplying of electric current, and to charge and demand from any such person or persons so contracting, rates and charges not exceeding those set forth in the schedule to the Act. Provided that the Governor in Council shall have the power from time to time to revise, and, if necessary, reduce such rates and charges."

The promoters are given power by Sec. 18 to make by-laws with regard to (*b*) the charges to be made to persons requiring to be supplied with electric current; (*c*) the interference with, or obstruction by, any person of any of the works authorised by the Act, while, by

Sec. 26, the Governor in Council may, from time to time, make regulations in accordance with the regulations for the time being of the Board of Trade of the United Kingdom, for securing the safety of the public from personal injury, or from fire or otherwise, and for minimising, as far as may be reasonable, any interference with the electric wires, lines, &c., of the Government.

The promoters are also under heavy responsibility to prevent their works occasioning any damage to anybody.

Sec. 33 of this Act, which related to compulsory purchase, was repealed by Act No. 24, of 1903, Sec. 3 of which provides that: "The Governor in Council, or any municipal Corporation, local board or other local authority, which may hereafter have jurisdiction over the lands served by the said tramway, shall be empowered, subject to the approval of the Parliament, at any time after the expiry of 21 years from the date of this Act coming into force, and after giving not less than six months' notice, to purchase and take the whole of the works authorised by this Act, and the promoters shall be required to sell, transfer and hand over to the Colonial Government, or any such corporation, board, or authority, the works so purchased, and the purchase price shall be paid to the promoters."

Any such purchase shall be effected according to the provisions of the Law No. 16 of 1872.* Thus Sec. 25 provides that "The promoters shall be answerable for all accidents, damages, and injuries happening through their act or default, or through the act or default of any person in their employment, by reason or in consequence of their works, cars, carriages, and for all damage done by electrolysis or otherwise, resulting from electric leakage, and shall save harmless all other road authorities, companies, bodies, collectively or individually, and their officers and servants from all damages and costs in respect of such damages, accidents and injuries."

Sec. 27 provides "That the promoters, subject to the acquisition of certain rights from the Government, shall have the right to purchase or take such lands as may be necessary for the purposes of (*inter alia*) carrying out and completion of any works under and by virtue of the powers and privileges granted to them by this Act. Provided that if the taking of any such lands shall cause damage to any person or his property, such person shall be entitled to compensation or recompense, to be settled in case of difference as if the claim constituted damage to land within the meaning of Sec. 65 of the Lands Clauses Consolidation Law.

"(*a*) That the purchase price shall be determined according to the value of the works at the time of purchase, without any addition in respect of compulsory purchase, statutory rights, goodwill, or profits, save as is provided in Sub-Sec. (*b*); and

"(*b*) That there shall be added to the value ascertained as aforesaid an amount as interest, equal to 10 per cent. on the value ascertained as aforesaid."

Sec. 34 provides that "Nothing in this Act shall be deemed to create a monopoly in favour of the promoters."

In 1903 the Natal Legislature passed another Act (No. 23 of 1903) entitled the "Sydenham Tramways, Lighting and Electric Current Supply Act." To all intents and purposes it is the same as the measure which we have just considered. There is one clause, however, to which attention should be drawn, namely, that which relates to injury to ocean cables or landline subsidised by the Government. It is there provided that:—

"If any ocean cable or the landlines connected therewith subsidised by the Government of Natal is at any time in any way injuriously affected by the construction by the promotors of their electric lines and works, or by the working of the undertaking of the promoters, the promoters shall pay the expenses of all such alterations in, or addition to, such cables or landlines as may be necessary to remedy such injurious affection. For the purpose of this section, a cable or landline subsidised by the Natal Government shall be deemed to be injuriously affected by an act or work if telegraphic communication by means of such cable is, whether through induction or otherwise, in any manner affected by an act or work, or by any use made of such work."

* A law which corresponds to the Lands Clauses Consolidation Acts.

The introduction of the above clause is interesting, and probably came about in consequence of the decision of the Judicial Committee of the Privy Council in the case of Eastern and South African Telegraph Co., Ltd., *v.* Cape Town Tramways Co.'s, Ltd. (1902) A.C. 381. It will be remembered that in that case the plaintiff company brought an action against the tramway company for disturbances in the working of their submarine cable caused by an escape of electricity stored by the respondents for the due working of their tramway system. It was decided in regard to that section of the tramway which had not been constructed under statutory authority, the principle of Fletcher *v.* Rylands (which imposes upon a man the duty of keeping anything dangerous on his own land in safe custody) did not apply in its entirety, because the disturbances only resulted when the cable was constructed without certain precautions which the evidence showed had subsequently secured its immunity.

It is probable that the Natal Act above-mentioned was passed with the express object of neutralising the effect of this decision, which would be considered binding upon all Colonial Courts in the British Empire.

(To be concluded.)

TRANS-ATLANTIC TELEGRAPHY.

By CHARLES BRIGHT, F.R.S.E., M.Inst.C.E., M.I.E.E.

At a recent meeting which had for consideration the proposed Imperial Atlantic Cable a resolution in its favour was, for some unaccountable reason, withdrawn. If the case against the cable was so strong, it seems strange that those opposed to it should ask for the withdrawal of a resolution in its favour; still more that those in favour should—out of awe or affection—fall in with so complacent a course on such an occasion. However, no reply having been given to the speech in opposition to the resolution, the following brief observations may be made in that connection:—

1. The existence of a trans-Atlantic cable monopoly *commercially* speaking has never been suggested, but our communication with Canada being now in the hands of two American companies constitutes a highly undesirable monopoly in a *national* sense.

2. A cable landed on British territory with British clerks, and *foreign ownership, directors, and managers*, does not constitute British control, as anyone knows who has to do with the working of a cable system. There are several cases that might be cited to prove this. Meanwhile, the following may be quoted from an American contemporary:—"The eight trans-Atlantic cables of the Western Union, Anglo-American, and Direct United States Companies were consolidated on March 8th, under one operating management, and will be known hereafter as the *Western Union Cable System*."* Here we have evidence of the way facts are appreciated at their correct value in the United States.

As further evidence, but from *this* side, we have the following remark made by the chairman of the Anglo-American Telegraph Co. at their last shareholders' meeting:—

"All we have to do now is to sit down and receive our dividends."

3. It is unwise to rely upon Naval supremacy as sufficient reason for allowing all our British trans-Atlantic cables to pass into American hands, especially when we remember that control of cable communication with other parts of the Empire is even more important during the period when International trouble is brewing, than during actual warfare. Germany and France have recently recognised this by establishing separate cable links to their own colonies.

4. The loss quoted on the Pacific Cable as of last year was, as a matter of fact, that of some years ago—a loss which is steadily decreasing each year. Parenthetically, it may be

* *Telegraph and Telephone Age*, March 16th, 1912.

added that we do not talk about a loss on our Navy and Army; yet efficient and reliable telegraphic communication with the rest of the Empire is equally essential, and is, indeed, *inter alia*, a necessary strategic adjunct.

5. As an argument against the proposed Imperial Atlantic Cable, it was stated that the line would require to be laid in duplicate. Personally, I should propose that the duplication should be effected by "wireless," either with the existing Marconi system or by establishing a new wireless system on an extreme northern route. But, in any case, it may be pointed out that, whereas a cable on the route of the "All British" Pacific Cable would be far more likely to give trouble than one across the Atlantic, the Pacific line has only once been interrupted—and that quite recently—for a very brief period, on one of the shorter sections. It has, in fact, got on very well by itself ever since it was laid some 12 years ago. On the other hand, its value as a strategic asset was more or less wiped out on the day when its Atlantic connecting links became entirely American.

6. A great deal was said about the Government wireless scheme; but though much was made of the cost of the proposed Imperial Atlantic Cable, there was no reference to the corresponding cost of the wireless project, a cost which has been already estimated at a figure considerably in excess of that which would be entailed by the Atlantic cable link.

7. A point was made that all the new wireless stations were to be on British territory. But this by itself does not appear to be of transcendent value in the case of wireless, unless the intervening æther space can be also rendered "All-British."

8. Apparently the principal opponent to the Imperial Atlantic Cable was greatly impressed with the efficiency of "Wireless"; for he spoke of the cable system as being conceivably "knocked out" by wireless. Suggestions of this sort, unfortunately have their effect when coming from certain quarters, even though based on no direct technical knowledge of the two methods of telegraphy. Thus, holders of cable stock are being needlessly disturbed, partly on this account and partly due to the constant "writing up"—very much "up"—in the non-technical press of everything to do with wireless telegraphy, without any corresponding announcement as to what is being done by cables in the ordinary every-day course.

9. Special attention was called to "a new automatic method by which messages would be ticked off at the rate of 50 words a minute." Apparently this had reference to the Imperial wireless scheme; and if this be so superior —as seemed to be thought— why trouble about cable rates? It was also stated that each station was to work "practically instantaneously," yet each was to "repeat to the other"; most of us know something of those repetitions, whilst we also know of the great value (and the reverse) of simultaneously spreading news and information to a wide and attentive audience—whether for legitimate Press purposes or otherwise. In the case of war it would be distinctly "otherwise."

The present position certainly suggests the desirability of full and important public inquiry into the relative merits of cable and wireless telegraphy—as I have constantly urged for. The two systems should, in fact, be put to actual test by independent parties under similar conditions. That would be better than mere generalisations such as seem so rife just now.

A Duchy Lighting Monopoly.—A combination of German manufacturing and financial interests is represented by the formation of the Thuringian Electricity Supply Co., of Gotha, which has been constituted by the A.E.G., the Electricity Supply Co., of Berlin, the Electricity Supply Co., formerly Lahmeyer and Co., the Bank for Electrical Enterprises, of Zurich, and the Electric Light and Power Investment Co., of Berlin. The object of the company, which will have a total share and bond capital of £600,000, is to work a concession granted by the State Ministry of Gotha, and unanimously approved by the Diet of the Duchy of Gotha, for the supply of light and power throughout the whole of the Duchy. It is proposed to erect a new power station for this purpose near Altenbreitungen, whilst the existing station at Gotha is to be acquired and enlarged. The stations will be connected together by means of overhead conductors, and will, therefore, be able to render mutual assistance. The scheme also provides for the construction of tramways.

WIRELESS TELEGRAPHY IN HOROLOGY, NAVIGATION AND CARTOGRAPHY.*

By S. M. POWELL.

An accurate knowledge of the exact time in a standard meridian, whether that of Greenwich or Paris, is essential to all clockmakers, public services (such as railways) and, above all, to navigators.

Whether in mid-ocean or "hugging the coast," the navigator must know precisely where he is at every moment, and, to obtain this information, he plots his course on a chart by aid of the magnetic compass and the log.† The inevitable errors in such a system of navigation are rapidly cumulative, and it is a matter of great importance to secure frequent astronomical observations, for the only changing feature from one part of the ocean to another is the aspect of the stars. The ascronomical observations enable a determination of the *latitude* of the place to be made, but to determine *longitude* involves a knowledge of the local time and of the corresponding time in a "datum" meridian (Greenwich or Paris). The local time is determined by a solar observation, and the datum time is transported by chronometers,‡ so that latitude and longitude are simultaneously determinable, and thence the precise instantaneous position of the vessel. The accuracy of the results obtained depends upon that of the sextant and of the chronometers; but, in any case, the errors are not so cumulative as those of "dead reckoning."

Harrisson's navigator's watch (1761-3) varied less than two minutes from correct time in a voyage of 147 days' duration, while Leroy and Berthoud's chronometers, of about the same date, kept the determination of longitude correct to 0·5°, six weeks after leaving port. Chronometers are still used for the transportation of datum time, and the advances of horology have evolved surprisingly accurate and compact instruments. Nevertheless, it is not easy to guarantee a knowledge of standard time, on long voyages, correct to within ½ second—this being a necessary and sufficient approximation in practice. For this reason it is usual to provide a check by carrying two, three or more chronometers, whose readings are carefully compared.

Again, land exploring parties must carry chronometers, if it be required to keep an accurate record of the route followed, and in this case the difficulty of transporting several instruments and preserving them from injury, by careless or curious native bearers, is enormous.

Whether on sea or land, the accurate determination of datum time has hitherto been costly, complicated and hazardous, but wireless telegraphy affords an avoidance, or at least a reduction of all

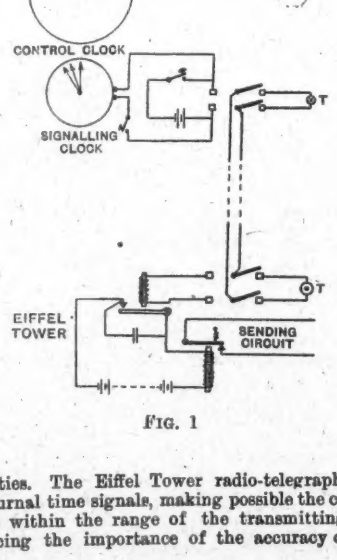


Fig. 1

three difficulties. The Eiffel Tower radio-telegraph station now despatches diurnal time signals, making possible the checking of all chronometers within the range of the transmitting station and greatly reducing the importance of the accuracy of these timepieces.

"*Wireless*" *Time Signals.*—Though the possibility of the wireless transmission of time signals was foreseen in the earliest days of wireless telegraphy, the limited range of action of the latter and the time lag of "coherer" detectors made an immediate application quite impracticable. Later forms of detectors led to extended range of operation and instantaneous telephonic perception of

* Notes compiled from similar articles in *La Lumière Electrique* and the Supplement to *La Technique Moderne*.

† Such is navigation by "dead reckoning"; the ship's position is determined on the chart by polar co-ordinates.

‡ No astronomical means of determining the "datum" time is sufficiently simple and accurate, under the conditions obtaining on shipboard.

signals, while a sufficiently powerful sending station is now to be found in the Eiffel Tower.

The French Central Marine Commission undertook experiments in 1907, which showed, among other things, that the Tower signals were received over a large part of the Mediterranean and the Atlantic coast of Morocco. The immediate effect of this observation was that Ferrié and Tissot carried out trial time signals between the Eiffel Tower and Brest (December, 1907). Chronometers at these two places were compared by aid of very short signals despatched at predetermined times. To approach conditions which would be likely to obtain in ordinary mercantile vessels, the experimental ship (anchored in the roads of Brest) was provided with a simple horizontal aerial, suspended some 20 metres above the deck. The high degree of accuracy with which the vessel's chronometers could then be compared with Paris time, proved that shipping could depend with certainty upon radio-telegraphic time signals. More ambitious trials were conducted under the supervision of Commander Guyou, with the final result that a regular diurnal series of time signals are now despatched by the Tower under the control of standard chronometers in the Paris Observatory. This service has been in continual operation since May 23rd, 1910, the morning signals, however, being only inaugurated on November 21st, 1910; mean Paris time is, of course, transmitted.*

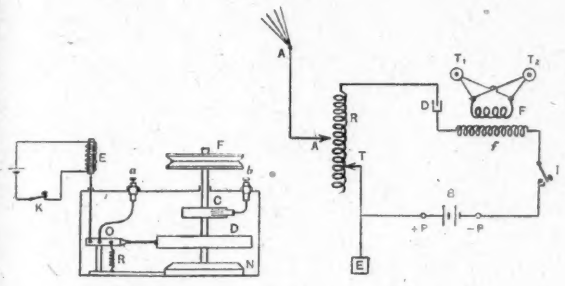


FIG. 2.

FIG. 3.

Two groups of signals are emitted :—(*a*) Warning signals; (*b*) actual time signals. To guard against vessels missing the warning signals and therefore failing to receive the actual time signals accurately, the latter are despatched thrice, at two-minute intervals, viz. :—At 11.0, 11.2 and 11.4 a.m. (day signals), and at 12.0, 12.2 and 12.4 a.m. (night signals).

The time signal is invariably a single short "dot," but the warning signals—ceasing two or three seconds before each time signal—are arranged as follows, so that confusion between the various time signals is impossible :—

At 11.0 a.m. (or 12·0 midnight) : Long dashes — — — — — —
At 11.2 a.m. (or 12.2 a.m.) : Dash, 2 dots, and so on — ·· — ·· — ··
At 11.4 a.m. (or 12.4 a.m.) : Dash, 4 dots, and so on — ·· ·· — ·· ··

The warning signals are sent by hand (key S, fig. 1), there being always an operator on duty at the Eiffel Tower and no great precision (of time) being required by these signals. The time signals, however, are despatched by the automatic arrangements shown in fig. 1, a duplicate subterranean operating cable being provided between the Observatory and sending station, and the correct working of the whole plant being tested some 15 minutes before each group of time signals.

In order to send out a time signal, a current of about 50 amperes must be temporarily established and then interrupted by a switch, relay-controlled from the Paris Observatory. This heavy-current switch is actually a converted mercury-jet turbine interrupter. As shown in fig. 2, a turbine N forces a mercury jet out through a pivoted nozzle O. Normally this jet clears the contact drum D, the nozzle being held down by the spring B, but, on exciting the coil E (from the Observatory, clock circuit), O is tipped and the mercury stream, impinging on the drum D, closes the main sending circuit. Directly the circuit of E is opened, the mercury jet is again diverted, and the "wireless" signal ceases. The mercury jet forms a non-arcing switch and is immersed in petroleum, alcohol or other dielectric liquid, to further ensure smart rupture of the main sending circuit.

It will be seen from fig. 1 that an appreciable time must elapse between the closing of the clock circuit at the Observatory and the emission of the time from the Tower. As this time lag is a constant amount, and as the time taken to propagate Hertzian waves (over the maximum range within which they can be received from the station), is negligible, it follows that the Observatory clock can be adjusted, once for all, to close its local circuit so much before 11 a.m. (or 12 midnight, &c.) that the actual time signal is heard thereafter, by all stations within range, at precisely the correct moment. This adjustment is made with the aid of a receiving station adjacent to the Observatory, and when effected, subsequent signals are emitted and received with an error certainly less than half a second (which approximation is amply sufficient, since 4 sec. represent one equatorial mile.)

* The German Norddeich station (at the mouth of the Elbe) has also instituted a service of time signals, the time transmitted in this case being that of the meridian of Greenwich. In March 11th, 1911 (some time after these notes were prepared), Paris time was put back 9′ minus 21″, and is now in agreement with Greenwich.

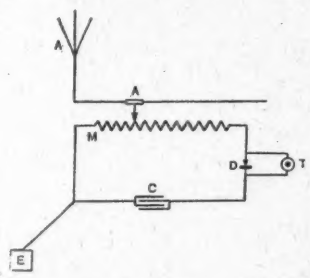
Receiving Time Signals.—Any existing land or ship wireless telegraphy installation can, of course, receive time signals without any additional apparatus, and as the tentative experiments of Ferrié and Tissot showed the special equipment required by any vessel, not already furnished with "wireless" apparatus, is quite simple and need cost no more than £10—£20 at the most.

The antenna required will be higher, the further the vessel is from Paris, but an elevation of 18-20 metres suffices for distances up to 250-300 km. (155-190 miles). A special receiving circuit, used only for the reception of time signals, has the considerable advantage that it may be tuned, once for all, to be syntonic with the waves radiated by the Eiffel Tower, thus becoming specially suitable for unskilled handling as well as simple and cheap in construction.

Two specially designed types of receiver now in use employ :—(*a*) An electrolytic detector; (*b*) a solid contact detector.

Type (*a*) is represented diagrammatically in fig. 3. It must be noted that though the absence of a transmitting circuit in these special sets considerably simplifies their arrangement as a whole, it usually removes all possibilities of charging secondary cells for use in the local circuit of the receiving detector. For this reason, two Leclanché cells are employed in the arrangement of fig. 3. An electrolytic detector, consisting of a lead cathode and dilute sulphuric acid electrolyte is connected as shown; the back E.M.F. of this detector is very slightly greater than that of the two Leclanché cells in series, so that the circuit may be left permanently closed without any fear of electrolysis of the detector or polarisation of the battery. No potential box is needed in the detector circuit, and, since the battery only gives current, and that of infinitesimal strength, during the short time occupied by the warning and time signals, it requires no more attention than the occasional making-up of evaporation. The transformer *f*, F (fig. 3) compensates for the small diminution of sensibility incurred by applying to the detector a voltage slightly less than its back E.M.F., and, further, allows of the use of ordinary, cheap telephones (of, say, 150 ohms resistance), instead of the costly, specially high resistance receivers (about 7,000 ohms), generally employed in wireless circuits.

The syntonic resonator, R, connected in series with the battery and detector (to the positive of each), avoids the necessity for a condenser in the circuit, thus further simplifying the apparatus, without at all detracting from its efficacy.



FIG

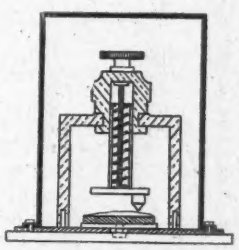


FIG. 5.

Type (*b*).—The great advantage of the following arrangement (figs. 4 and 5), is that it avoids the necessity for a local battery and "volt box" by the use of a rectifying, solid contact detector.*

Referring to fig. 4, a rectangular Oudin resonator forms the secondary of the receiving circuit, and is once for all tuned to the wave length of the Eiffel Tower waves. The whole may be used with *any aerial* system, and the robust detector employed needs a minimum of care and skill in its manipulation. The primary of the resonator, connected between aerial and earth, consists of the turns between the cursor A and terminal M. By traversing the cursor A, the best receiving position is soon found, the closed resonant secondary circuit rendering tuning very sharp and allowing of the elimination of parasitic signals (by its very arrangement the receiver can only detect signals of the Tower wave length, a fact further obviating the risk of confusion).

Wherever the Eiffel Tower time signals can be received, a good watch keeps sufficiently accurate time, *subject to this diurnal control*, for all practical purposes; to facilitate comparisons between the watch or chronometer and the time signals, the former should be mounted as near as possible to the receiving apparatus. The present effective radius of transmission of the Tower—for such work as the above—is about 2,000 km. (1,250 miles), and will be considerably greater when the new station is in operation. As already explained, the utility of these diurnal time signals extends, not only to mariners and explorers, but also to towns far from an Observatory, to postal authorities, to railway companies and similar bodies and to individual experimenters and clockmakers.

The Accurate Determination of Differences of Longitude.—Though a single "dot" signal suffices to give a time notification accurate enough for ordinary navigating and similar purposes, it is insufficient to fix the precise value of a *difference of longitude* to that

* Lead sulphide or galena, mounted in a brass cup, forms the fixed contact, while a piece of cast zinc oxide, mounted in a metallic capsule constitutes the adjustable contact. The latter is held down by a suitable spring and guide-piston as shown in fig. 5. The whole is protected by a brass shell secured by a bayonet joint, and capable of being turned through 30° in one direction or the other, to place the electrodes in or out of contact.

degree of accuracy requisite in cartographical and similar work. Instead of accuracy to within 0·5 sec., it is now required to make time comparisons correct to some hundredths of a second. This result has been attained by emitting a sustained train of Hertzian "dots," then applying the principle of *coincidences*, as below.

Two stations, A B, whose difference of longitude is required—for mapping or other purposes—or whose chronometers are to be accurately compared, are provided with second pendulums. At a

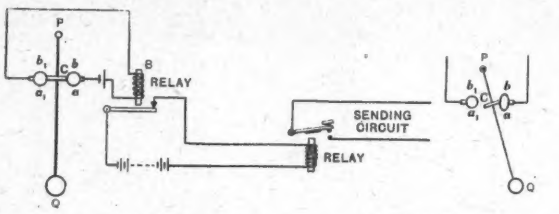


FIG. 6.

FIG. 6A.

third—reference—station (here the Eiffel Tower), a pendulum beating, say, $1\frac{1}{100}$ sec., controls the "wireless" transmitting circuit, and thus sets up a train of "dots" at intervals of $1\frac{1}{100}$ sec. (see figs. 6 and 6A).

Both stations A B hear these "dots" in their receiving telephone, and, superposed thereon, the beats of their own "local" clocks. The latter result is secured by mounting microphones in the cases of the clocks concerned; the microphone currents traverse an induction coil, the secondary of which is shunted across the receiving telephone (see fig. 8). Regulating resistances in the primary (microphone) and secondary (telephone) circuits, enable the local beats to be adjusted to the same quality and intensity as those of the Eiffel Tower—heard through the intermediary of wireless telegraphy.

Each observer, A B, will hear his local beats gain on, coincide with, and gradually recede from those of the Tower, this cycle being indefinitely repeated, and a coincidence of beats being heard whenever the faster pendulum gains one beat on the slower. These periodical coincidences form the basis of the whole method; they may be detected with great accuracy, and all each observer has to do is to count the number of Eiffel Tower beats between each coincidence, and note the time shown by the local clock at the occurrence of each.

Suppose, for instance, that A hears a coincidence at 10 hr. 7 min. 3 sec., after the Tower clock has beaten 182 times, and that B hears a coincidence at 12 hr. 17 min. 43 sec., at the 195th beat. Between these observations there elapses (195 − 182) × 1·01 sec. = 13·13 sec. Hence, when A's clock shows 10 hr. 7 min. 3 sec., B's shows 12 hr. 17 min. 43 sec. — 13·13 sec., *i.e.*, 12 hr. 17 min. 29·87 sec.; similarly when B's clock shows 12 hr. 17 min. 43 sec., A's shows 10 hr. 7 min. 16·13 sec.

It is thus possible to determine, very accurately, the *simultaneous* local times in the stations A B, and thence, in the ordinary way, and to an equal degree of accuracy, the difference of longitude between the two places.

The origin from which the beats of the Tower pendulum should be counted is determined thus:—The pendulum is started at an approximately fixed time (determined in advance). After a certain time, an interrupter opens the relay circuit for one beat, thus missing one signal. The observers at A B note this interruption, and thence count 1, 2, 3, &c., starting on the next beat. At beat

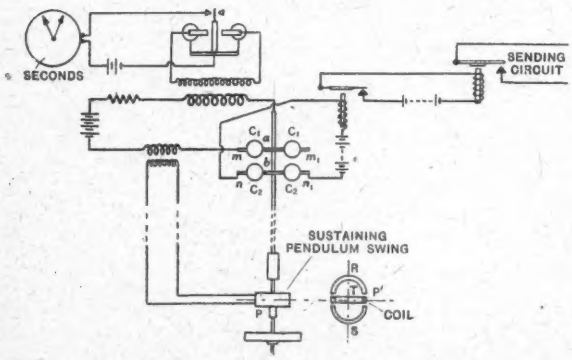


FIG. 7.

60 a further gap is created, and observers who missed the origin can thus pick up the sequence and go on 61, 62, 63, &c. At beat No. (120 + 10) = 130 the sending circuit is again opened and further checking points are thus afforded from time to time, the interval between gaps being increased by 10 beats per gap. At whatever point an observer may "break in," it is possible for him to refer his observations to the true origin of the series of Tower beats, by noting the number of beats to the next gap and the succeeding interval between gaps.

The Eiffel Tower signals are controlled by an electromagnetically maintained Lippmann pendulum (figs. 6 and 7) adapted to its present use by the addition of two silver bars *a*, *b* (fig. 7) which make contact with rings c^1 c^1, c^2 c^2 of silver thread mounted on supports *m n*, m^1 n^1, which are capable of micrometric adjustment to vary the duration of the contact effected by the rings c^1 c^1, c^2 c^2. The latter ensure an even contact, of any duration requisite to ensure correct working of the relay R (which controls the mercury turbine contact maker, see fig. 2) and this without disturbing the correct oscillation of the pendulum. In order to reduce the delicacy of the latter, it is found advisable to use a half-second pendulum, making contact in the relay circuit once per complete oscillation instead of once per swing.

Tests of the Above Method.—Tests were initiated in January, 1910, by the collaboration of the Bureau des Longitudes, the Montsouris Observatory and the Eiffel Tower authorities. The preliminary tests showed that no personal equation was involved in the measurements, and that the time lag of the transmitting apparatus was sensibly constant. The maximum error in the observation of a coincidence was never greater than a single beat; and the mean of eight comparisons made by two observers agreed to within $\frac{1}{1000}$ sec., the mean error on a single observation being ± 0·006 sec.

These experiments were soon interrupted by the Seine floods (which disorganised the Eiffel Tower plant), but were resumed in

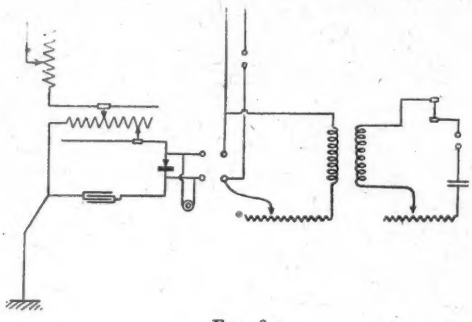


FIG. 8.

July, 1910, when the results already obtained were verified, the complete practicability of the whole scheme being so clearly demonstrated that the method is soon to be applied to cartography in Africa (see below).

The results obtained in the Montsouris-Brest trials were checked by the direct telephonic transmission of signals. The maximum discrepancies between the time comparisons,* effected by telephone and by "wireless," were less than 0·01 second,† and it was found throughout that the wireless signals were received with greater ease and consistency than those transmitted over wires.

The wireless determination of differences of longitude (primarily, of course, differences of time) is highly convenient and accurate, and possesses the important advantage of making possible simultaneous comparisons between any number of pairs of stations within the range of the standard or reference station.

Large ports and inland towns are gradually being provided with wireless telegraph apparatus, and it does not seem too much to predict that in the comparatively near future, vessels on all the oceans of the world will be able to receive daily time signals and probably various meteorological signals, useful to the navigator. When within 200 or 300 miles, at least, of land they will be able to locate wireless "beacons" with an error not exceeding 2°§. The dangers of lost bearings and of collision or shipwreck in fog or on dangerous coasts will be almost eliminated, and assistance will be summoned, in case of necessity, with maximum rapidity and certainty.

Again, starting from various wireless stations skirting unknown territory, the difference of longitude between these reference bases, and distant or inaccessible places (reached only by explorers and the required few observers with a simple portable wireless receiving apparatus, and a clock showing the time of the place), will be obtained with an ease and accuracy hitherto unattainable.

Various blanks in the map of Africa are soon to be filled in by this method. The Etablissement Militaire de la Telegraphie is at present organising a vast radio-telegraphic network in Africa. Stations at Rufisque and Port Etienne are already complete; stations at Dakar, Konakry and Monrovia are under construction, and schemes are on foot for stations at Loango and Brazzville, Tchad and Sénégal, Timbuctoo, Tabou, Kotonou and Grand Bassam.

This vast network will be completed this year and will result in a triangulation closing on Paris and the Navy and Administration des Télégraphes stations at Bizerta, Oran and Algeria.‖ No more striking instance could be quoted of the tremendous possibilities lying before wireless telegraphy—some known, but unutilised, many more probably yet to be conceived.

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* Mean Paris time and sidereal time at Brest.

† The telephonic comparisons agreed to within less than 0·003 second, while the more readily effected wireless comparisons agreed to within 0·009 second (maximum error).

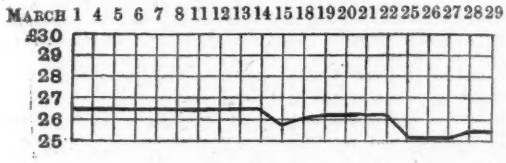
§ See "Syntony and Directive Wireless Telegraphy," ELECTRICAL REVIEW, December 15th, 1911, page 974.

‖ Measurements of the longitude differences Paris-Bizerta, Paris Dakar, are to be commenced at once. The Rufisque station signals have been received at the Eiffel Tower, though the power employed is only 5 KW., and the route (4,700 km., *i.e.*, 2,937 miles) is mainly over land.

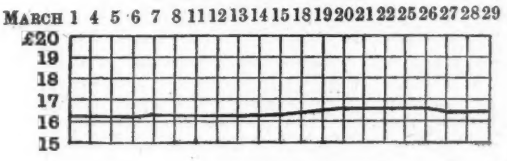
METAL MARKET.

Fluctuations in March.

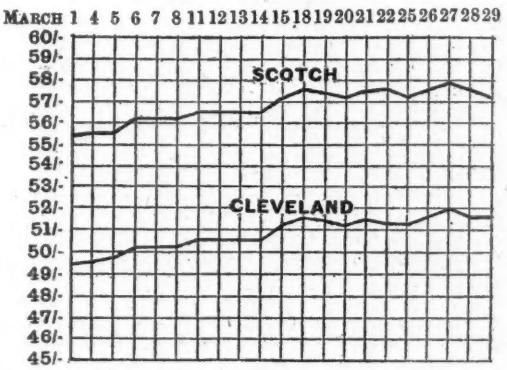
SPELTER (G.O.B's.).



LEAD (ENGLISH).



IRON.



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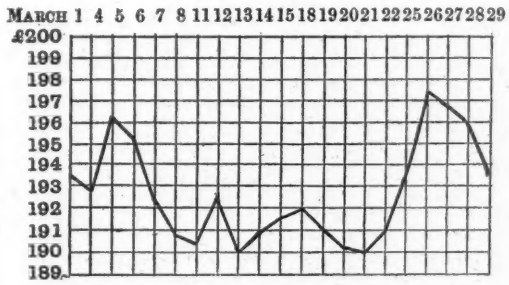
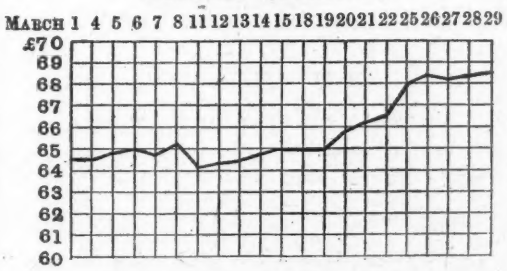


COPPER (G.M.B's.).



Agricultural Machinery Competition.—An international competition of motor-driven agricultural machinery is to be held in Monte-Video from April to October this year, as the result of the efforts of the Ministry of Trade to further the use of agricultural machinery in the Republic of Uruguay. Some 60 motor ploughs are already in use, mostly supplied from England and the United States. A jury has been named, the chairman of which is Engineer Otto Kasdorf, the head of the testing department of the Agricultural High School, who has drawn up the regulations of the competition, which aims to be purely practical, the show element as far as possible being eliminated.—*Zeit. Oest. Ing. und Arkt.*

LEGAL.

BAILEY *v.* WENDON.

On March 27th, before his Honour Sir W. L. Selfe, in the West London County Court, C. J. Bailey, electrical engineer, of 45, Grafton Road, West Kensington, sued James Wendon, of Fulham Palace Road, for £15, the value of a dynamo which he was detaining. The facts were that the defendant had let 158, Fulham Palace Road to a Mr. Lawrence, and about the end of August he sold to the plaintiff a dynamo of the Manchester type for £15. After the bargain was struck the machine was left with Lawrence to sell, plaintiff at the same time saying that he also would endeavour to find a purchaser. Some weeks passed by and Mr. Reginald Wicks, of 231, Kilburn Park Road, manager of the Paddington Tyre Company, hearing that the dynamo was for sale, offered £20 for it. When plaintiff and he went to 158, Fulham Palace Road to view the purchase, Lawrence had gone, after handing over all his debts and goods to the landlord, the defendant, in satisfaction of £139 rent overdue. When applied to to deliver up the dynamo, Wendon declined unless Lawrence was produced to say that the dynamo was plaintiffs. As that person could not be found, defendant stuck to the machine. After evidence, the jury found that the dynamo was the property of the plaintiff, and gave a verdict in his favour, assessing the value of the dynamo at £10, and awarding him damages. His Honour entered judgment for delivery up of the dynamo on the payment of £10, with the damages and costs on the lowest scale.

COOPER *v.* L.C.C.

On Tuesday, March 26th, P. Cooper, an ironmonger, of High Street, Deptford, sued the L.C.C. for damages for injuries caused to him through the alleged negligence of defendants' servants. On July 14th last plaintiff was on his way to his Deptford premises, when, in crossing the road, he was knocked down by an electric tramcar near the Broadway, Deptford. The defence was contributory negligence on the part of the plaintiff, but the jury found for the plaintiff, with £300 damages. Judgment accordingly, with costs.

[Other Legal matter will be found in our "Notes" pages.]

The Transfer of Municipal Works in Germany.—A new phase of the question of electrical monoplies in Germany has now arisen in connection with electric supply works. As is well-known, various Federal Governments in that country have issued orders warning the local authorities against entering into agreements which would confer upon any firm a monopoly of the supply of installation materials, motors and accessories, lamps, &c., in respect of central or overland stations, whilst at the same time the Government officials have been instructed to refuse to sanction any agreements between local authorities and manufacturing firms which would result in the latter obtaining a direct or indirect monopoly. It is now of some interest to observe that the Saxon Ministry for Home Affairs has taken a further step by the issue of an order advising the local authorities who own electric supply works against the sale or leasing of the works to large electricity concerns. It is pointed out, in the first place, that if the communal works in Saxony should gradually decrease in numbers and pass into private hands, the danger would arise that the country would become dependent upon a few large private undertakings for the supply of current. In the course of time such dependence, both in connection with the fixing of prices for currrent and in other respects—as, for instance, the construction of tramways—would turn out to be very oppressive. The Ministry, therefore, wishes that all communal authorities and combinations of such authorities should clearly understand the serious consequences which would follow, and what great responsibility they would assume, if they took the step of disposing of their works to private companies. This situation would not be changed in any way by momentary advantages and financial relief, or by long term contracts in regard to the obtaining of current. By the sale of their works the communes might irretrievably surrender the important right of fixing the conditions for procuring electric power according to their own estimates. This right would become of greater importance in the future, as industries and small trades are adopting electricity in an increasing degree, and the requirements of individual households are constantly growing. The order proceeds to remark that if an electricity works has to contend with difficulties in the early years of its existence and requires financial grants in aid, this is not a sufficient reason for disposing of it to a private contractor. Works which have for a long time past yielded profits have also had to pass through such unfavourable times, and the interests of a distant future should not be forgotten in connection with present unsatisfactory annual balance-sheets. The Ministry does not wish to limit in any way the local right of self-government, but it is desired that the local authorities should recognise more than hitherto that they have to defend this right also in relation to private enterprise. It is considered that the reasons adduced in the order against the sale of supply works are equally applicable to the leasing of works, as, after the expiration of the lease, especially if it extends over several decades, the lessor for technical and economic reasons would never again be able to take over the working of the undertakings.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

NEW ZEALAND.—The New Zealand Customs Authorities have decided that the bar dial bridge (a Wheatstone bridge) shall be dutiable at the rate of 20 per cent. *ad val.* if of British origin, and at the rate of 30 per cent. *ad val.* if of foreign origin.

The New Zealand Minister of Customs has isued an order to the effect that every entry for *ad valorem* goods imported into the Dominion shall have endorsed thereon, or shall be accompanied by, a declaration in a prescribed form, and that such declaration shall be signed by the person making the same in the presence of one of the undermentioned persons, viz.: a collector of customs, a proper officer of customs acting for such collector, a postmaster or a Custom House agent. The form of declaration is to be filled up as directed by or for the importer of the goods and no declaration will be deemed sufficient to enable an entry to be passed at the Customs until so filled up and until every alteration or correction thereon has been initialled by the declarant and by the person before whom the declaration is made.

SOUTH AFRICA.—The South African Customs Authorities have decided that electric detonators and fuses are to be dutiable at the rate of 15 per cent. *ad val.* if of foreign origin, and at the rate of 12 per cent. *ad val.* if of British origin.

AUSTRALIAN COMMONWEALTH.—The Australian Customs Authorities have recently issued the following decisions as to duties to be levied on certain electrical and similar goods. In all cases the duties quoted are those under the British Preferential Tariff:—

Glass globes with metal neck and cap perforated to admit electric wires. (Used to protect electric lights in exposed places.)	10 %
Automatic switch with overload coils and transformers attached	Free.

CORSICA.—A Bill has recently been laid before the French Chamber of Deputies and referred to the Customs Commission, proposing to modify the existing Customs régime in Corsica. This Bill provides that foreign products shall, on importation into Corsica, pay the same rates of duty as those leviable in France. At present, goods are dutiable at rates leviable under a special Corsican tariff which although framed on the French tariff, is not absolutely identical.

SALVADOR.—A Decree has recently been issued by the Salvador Government reducing the surtax on imported goods in general from 20 per cent to 14 per cent. This Decree was to come into force 60 days after its publication, which took place on September 19th last.

PANAMA.—The fee payable to Consuls of Panama for certifying a set of bills of lading, has been reduced from three dollars to one dollar in cases where the value of the goods entered on the bills does not exceed 100 dollars.

GRENADA.—The Grenada Government have recently promulgated a new Customs Tariff. Under this tariff the duty to be levied on "unenumerated articles" has been raised from 7½ per cent. *ad val.* to 10 per cent. *ad val.* This duty would apply to most electrical and similar goods which are not admitted free of duty (see statement as to the duties on electrical goods in Grenada published in the ELECTRICAL REVIEW.

NEW PATENTS APPLIED FOR, 1912.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

6,634. "Multiple control of electric motors." R. RICHTER and MAFFEI-SCHWARTZ-KOPFF WERKE G.M.B.H. (Convention date, April 21st, 1911, Germany.) March 18th. (Complete.)

6,639. "Selective electric signalling on omnibus circuits." G. H. CROOK. (Addition to 8,283/1911.) March 18th. (Complete.)

6,640. "Selective electric signalling on telephone exchange party lines." G. H. CROOK. March 18th.

6,645. "Electric medical appliance." E. T. BRAARUP. March 18th.

6,647. "Alternating current electricity meters." SIEMENS SCHUCKERTWERKE G.M.B.H. (Convention date, March 18th, 1911, Germany.) March 18th. (Complete.)

6,650. "Electric ear trumpet." J. GREEN. March 18th.

6,653. "Automatic arrangement for giving a small and a large gear ratio between two shafts for starting internal combustion engines with small electric machines." P. L'R. FRASER. March 18th.

6,655. "Vapour electric apparatus." M. A. E. LEBLANC. March 18th.

6,656. "Remote control electrically-operated lock." G. W. PEARSON. March 18th.

6,670. "Suspension of overhead conducting wires for electric railways." A. G. BLOXAM. (Bergmann-Elektricitäts Werke Akt.-Ges., Germany.) March 18th. (Complete.)

6,673. "Switches combined with plug terminals for electric circuits." W. E. WATSON. March 18th.

6,716. "Distance operated mechanisms and signals on electric supply systems." H. W. HANDCOCK. March 19th.

6,752. "Electrical signs." T. PYBUS. March 19th.

6,758. "Batteries." W. C. BANKS and R. C. WOOD. March 19th. (Complete.)

6,763. "Electrical heating apparatus." L. G. BYNG and J. H. COLLINGS. March 19th.

6,772. "Electrostatic separating devices for sorting heterogeneous materials, more especially minerals, metallic and others, sulphur, phosphates of lime, and like materials." A. M. F. BLANCHARD. March 19th.

6,778. "Tungsten or the like metal filament and a process of manufacturing the same." J. HUBERS. (Julius Pintsch Akt.-Ges., Germany.) March 19th.

6,785. "Primary batteries." T. A. TAYLOR and T. H. JONES. March 19th. (Complete.)

6,803. "Electrical distribution apparatus." J. BIJUR. March 19th. (Complete.)

6,807. "Electric arc lamps." G. E. TATE. March 19th.

6,828. "Electric governors for engines." S. RUMOLINO. (Addition to 29,754, 1909.) March 19th. (Complete.)

6,832. "Callendars for use in connection with telephone instruments." F. S. POCOCK, E. S. SIBUN and L. G. CROOK, trading as Pocock & Sibun. March 19th.

6,857. "Wind-driven electric generator apparatus." J. L. NOBLETT. March 20th.

6,882. "Method of restraining the augmentation of an electric current and contrivance therefor." A. N. HAZLEHURST and LONGSTRETHS, LTD. March 20th.

6,889. "Graded service automatic telephone system." H. BARON. March 20th. (Complete.)

6,918. "Method of and apparatus for making incandescent lamp bases and the like." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) March 20th.

6,920. "Conduits for electrical cables and the like." M. KAHN. March 20th.

6,923. "Safety apparatus for electrically-propelled trains." SIEMENS BROS. DYNAMO WORKS, LTD., and F. LYDALL. March 20th.

6,946. "Cover for electric arc and gas incandescent lamps to prevent dust nuisance during cleaning operation." S. A. MOSS and A. G. MOSS. March 21st.

6,961. "Connection box with revolving contacts." L. M. WATERHOUSE and SIMPLEX CONDUITS, LTD. March 21st. (Complete.)

6,962. "Apparatus for the generation of electricity from the motion or currents of water." A. VISSER, J. H. DE GOEDE and J. DE VEEN. March 21st. (Complete.)

6,977. "Apparatus for indicating speeds at a distance." SIEMENS BROS. AND CO., LTD. (Siemens & Halske Akt.-Ges., Germany.) March 21st. (Complete.)

6,988. "Inductor alternator." E. PODESAN. March 21st. (Complete.)

6,990. "Reverse current relays." E. MÖLLER. March 21st.

7,014. "Relays for electric control systems." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) March 21st.

7,044. "Continuous current electrical machines without commutators." F. MACKINTOSH. March 22nd.

7,053. "Electrical resistance used for heating purposes." F. B. COX. March 22nd.

7,055. "Electric motor controllers." J. W. GIBSON and J. H. GIBSON. March 22nd.

7,056. "Lamp pillars for electric lighting." J. SOUTHALL. March 22nd.

7,057. "Electric and other lamps and their attachments." J. T. DALLAWAY. March 22nd.

7,087. "Electric lamps with concentrated illuminating effect." H. HIRSCH. March 22nd.

7,096. "Cam regulating mechanism." BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitäts Ges., Germany.) March 22nd.

7,097. "Method of fixing contacts to springs and the like for electrical purposes." TELEPHON APPARAT FABRIK E. SWIRTUSCH & CO. G.M.B.H. (Convention date, March 22nd, 1911, Germany.) March 22nd. (Complete.)

7,100. "Telephone systems." E. A. MELLINGER. March 22nd. (Complete.)

7,102. "Electric couplings." J. MAY. March 22nd.

7,115. "Switch for controlling electric circuits." H. S. BENSON. March 23rd.

7,133. "Electro-mechanical transmission systems for vehicles." H. PIEPER. (Convention date, April 29th, 1911, Germany.) March 23rd. (Complete.)

7,135. "Arrangement for starting groups of electrical machines consisting of a synchronous and an asynchronous machine connected in cascade with it." W. P. THOMPSON. (Ateliers de Constructions Electriques de Charleroi, Belgium.) March 23rd. (Complete.)

7,137. "Means for supporting electric lamps." L. G. BYNG and J. H. COLLINGS. March 23rd.

7,145. "Switches for electric circuits." I. DEUTSCH. (Convention date, March 23rd, 1911, United States.) March 23th. (Complete.)

7,146. "Electrically operated switches." R. WIKANDER. (Convention date, March 23rd, 1911, United States.) March 23rd. (Complete.)

7,147. "Electromagnet apparatus." H. A. LEWIS. (Convention date, May 22nd, 1911, United States.) March 23rd. (Complete.)

7,148. "Electric incandescent lamps." R. H. HENDERSON. (Convention date, March 23rd, 1911, United States.) March 23rd. (Complete.)

PUBLISHED SPECIFICATIONS

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1910.

SYSTEMS OF ELECTRICAL TRANSMISSION.] [H. Leitner. 27,395. November 24th.

1911.

DEVICE FOR SUPPORTING OR SUSPENDING ELECTRIC LAMPS AND THE LIKE. G. P. Kent and A. R. Mitchell. 4,491. February 22nd.

ELECTRIC CIRCUIT CONTROLLING APPARATUS FOR TRAIN LIGHTING AND SIMILAR SYSTEMS. Electric and Ordnance Accessories Co., E. H. M. Langley and F. W. Price. 5,005 and 5,012. February 28th.

ELECTRIC TRANSFORMERS. A. E. Berry. 5,190. March 1st.

TRANSMISSION OF LIGHT PICTURES IN ELECTRICAL TELESCOPIC AND SIMILAR APPARATUS. B. Rosing. 5,486. March 4th.

AUTOMATIC REGULATING DEVICES FOR ELECTRIC SUPPLY SYSTEMS. H. Lake. (United States Light and H ating Co.) 7,590. March 26th.

CONTROLLERS FOR ELECTRIC MOTORS. British Thomson-Houston Co. and N. Wise. 8,238. April 3rd.